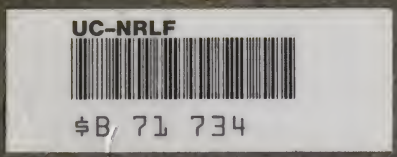

INVESTIGATION

MADE BY THE

STATE BOARD OF HORTICULTURE

OF THE

CALIFORNIA OLIVE INDUSTRY

DEVELOPMENT OF THE INDUSTRY, UNFRUITFULNESS OF VARIETIES, METHODS OF CULTURE, PRUNING, PROCESSING OF FRUIT, ETC.

REPORT TO GOVERNOR GAGE.

SACRAMENTO:
A. J. JOHNSTON, : : : SUPERINTENDENT STATE PRINTING.
1900.

FLOWERING OLIVE BRANCH—(Natural Size).

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California State Board of Horticulture,
Sacramento, February 28, 1900.

To His Excellency Henry T. Gage, *Governor of California:*

Sir: Urgent requests having been made to this Board for an investigation of the supposed unfruitfulness of the olive in different portions of the State, and also for information on methods of planting, pruning, extraction of oil, etc., it was determined to make an examination of the causes of complaint and to furnish the desired information. These deductions, in concise form, are embodied in the report herewith submitted by our Secretary, who was detailed to make the investigation, being a research covering almost every section of the State where the olive is grown. The investigation not yet being complete, this will form part of a report on same, to be concluded in our Biennial Report at the close of the present fiscal year.

Respectfully submitted.

ELLWOOD COOPER,
President.

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CALIFORNIA OLIVE INDUSTRY.

By B. M. LELONG, Secretary of State Board of Horticulture, and Chief Horticultural Officer of California, aided by growers throughout the State.

Historic records tell us that the olive tree was introduced into California in 1769, from San Blas, Mexico, by an expedition of Franciscans sent to take charge of the Jesuit missions in California. It appears from the ship's manifest that one José de Galvez, who was "Visitor-General" and secular head, with Father Serra, proceeded to make arrangements for the establishment of settlements. He seemed to be farseeing, for it was found that he had caused to be shipped to "Alta" California, flower, vegetable, and fruit seeds for garden and orchard, and grain for the field. The ship's manifest does not show that any trees or cuttings were brought.

The first seeds of the olive are said to have been planted at the Mission San Diego, and those seeds (which Galvez had been so provident in sending) grew and prospered. The Fathers built new missions, and among the first trees planted was the olive, grown from cuttings taken from trees of the San Diego mission. All the mission orchards were very small, and some had but few trees, but those trees played an important part in the horticultural history of our State, for they laid the foundation of a gigantic industry and furnished stocks for many groves, which to-day may be styled the "prehistoric" orchards of the State.

For many years, a century or more, only one variety of olive, the "Mission," so called from its having been first grown at the various historic missions, was known in the State. Many of those trees still live and bear remunerative crops under favorable conditions. That the larger part of these primitive trees were grown from seed there is but little doubt, for in almost every mission olive orchard there are trees growing side by side of entirely distinct types. Some are of a

willowy habit, the fruit large and roundish, which matures early and evenly; others are tall, lofty, sturdy trees, bearing elongated fruit and of very uneven ripening; while still others are of a dwarfish habit of growth, the fruit small and of very little value. It is not uncommon to find olive plants that have sprung up spontaneously under trees from pits of fruit that dropped, especially where the soil had not been disturbed for a season. I have gathered many such plants for several seasons. It is reasonable to suppose that this also occurred in the primitive days at the mission orchards; the plants, no doubt being cared for, in time became as large as their parents and to-day are probably numbered among the historic trees of our State. This no doubt is also accountable for the great variability of the different types of the Mission olive found in different localities, and especially in mission orchards.

In the matter of climate, California is well adapted to olive culture. The tree requires a moderately uniform temperature and will not withstand extremes of either heat or cold. It is essentially a fruit requiring an invariable climate, being found between 45 degrees north and 18 degrees south. The altitude at which the olive will grow depends upon the latitude. The farther north we go in the olive belt the lower the altitude at which it will thrive, and the farther south the higher the altitude suited to it. In the Sierra Nevada range, in latitude 37 degrees north, it will do well at 3,000 feet. Locations visited daily by a gentle breeze, especially in the blossoming season, are well suited to the olive, while intense heat at this period may ruin all prospects of a crop, and a low temperature, say 14°, is fatal to the tree, while 26° is fatal to the fruit.

The culture of the olive for commercial purposes forms an industry that, with proper protection, should be regarded as one of the safest in California, and under favorable conditions the most profitable of all branches of horticulture. Large areas of land have been planted to this fruit, in most of which it finds all the conditions of soil and climate perfectly adapted to its growth and fruitage.

*"The published estimate of the number of olive trees (by County Assessors to the State Board of Equalization) now growing is 2,500,000. The number of pounds that a tree

*Address by Hon. Ellwood Cooper, State Fruit-Growers' Convention, November, 1897.

in full bearing will produce under favorable conditions is 250. For the purposes of this article we will assume that the trees will bear only in alternate years; we will allow also, for deficiencies from various causes, 20 per cent; we will then have 250,000,000 pounds. Allow one half of this product to be pickled and dried, which would amount to 400,000 barrels of 50 gallons each—6,000 carloads. The other, to be made into oil, would give 1,000,000 cases of 12 bottles each—2,000 carloads. According to correspondence which I have in my possession, there will be a large additional planting this coming season. Can such quantity be sold under present conditions? This condition of the industry should be carefully considered by those who have orchards, and especially so by those who intend planting. We have, therefore, a great missionary work to do in educating the human family up to the realization of the importance of consuming the product of the olive tree. That such knowledge sooner or later will be universal among intelligent people is my conviction. Also, that the object of our energies and labor: to work for the health, happiness, and prosperity of unborn generations, is a very worthy one. But we want something ourselves. The greatest drawback to the sale of olive oil is the adulterations and substitutions put on the market with fraudulent labels and fraudulent statements; the purpose being to deceive the consumers for larger margins of gain. The difficulty in selling the olive pickles arises from want of knowledge in processing them or from want of care. There is now an active market for the ripe Mission olive, if well pickled, and if the growers will take the care and do it properly there will soon be a market for a very large quantity."

THE OLIVE.

The Genus OLEA, Linnæus.—Calyx-Perianth (floral envelope) monophyllous (one-leaved), tubular, small, mouth quadridentate (having four teeth on the edge), erect, deciduous (falling off). Corolla monopetalous, infundibuliform (funnel-shaped); tube cylindrical, of the length of calyx; limb quadripartite (divided to the base into four parts), flat, laciniæ (narrow, slender portion of the edge) semi-ovate. Stamens two, filaments opposite, subulate (awl-shaped), short; anthers erect. Pistil germ subrotund (almost round); style simple, very short; stigma bifid (two-cleft), thick, laciniæ emarginate (notched at the summit). Drupe (stone fruit) subovate, glabrous (hairless), unilocular. Seed an ovate-oblong (oblong with one end narrower than the other), wrinkled nut.

The Flower or Blossom.—The flower or blossom of the olive develops and is borne on growth of the preceding year. The olive puts forth growth in the spring immediately after the awakening of vegetation. The leaves of the first development appear of a lighter green than the others. A little before the beginning of April (in warm regions, in March) there appear in the axis of the first leaves greenish panicles, sustained by a common peduncle; in proportion as the system gains in consistency and growth these round panicles take a pyriform shape, and at this stage may be seen appendages or stipules turned down; this is the bud of the blossom, which discloses in most sections in May, and in some (along

Flowering olive branch—reduced one half.

the coast and in the bay counties) not before June, while in the warm regions as early as March or April. The olives produced from the flowers first expanded are the most certain to reach maturity, the second less, while those of the last are generally lost. The bloom is susceptible to extremes of cold or heat. A continued hot spell, rain, cold, or wind during the blossoming time prevents fecundation.

The floral symmetry of the olive is very characteristic. The fruit presents variations, the importance of which has been diversely appreciated according to the epoch and the state of science. At the time when external morphology alone was furnishing characters, the fruit, with its different forms, seemed of capital importance. Now it is known that its origin is always the same, that its differences are superficial, and more important and desirable characters are preferably considered.

Leaf.—The leaves of *Oleaceæ* are opposite, seldom being alternate, simple or paucifoliate (a few leaflets), pennate (feather-shaped), entire or toothed, always destitute of stipules (appendages at the base of leaves). The leaf is always covered by an epidermis formed of a single layer of cells rich in tannin.

Fruit.—The fruit is a drupe, fleshy, drupaceous (of the form of a drupe) or bacciform (of the form of a berry), indehiscent (not opening spontaneously at maturity); two ovules in each cell, laterally fixed near the summit. Seeds single by abortion, of three ovules, rarely two, in each cell; seed albuminous, with superior radicle. Inflorescence paniculate, trichotomous (divided in threes), or fasciculate (growing in bunches), with centripetal primary branches, sometimes centrifugal.

PROPAGATION.

From Seed.—Propagating olive trees from seed is very tedious, and requires extraordinary care. The pits are quite hard, often requiring from one to two seasons to germinate. The raising of olive plants from seed is the most natural method, and the one producing the most healthy and robust trees, the

roots being more symmetrical; but as the plants make slow growth the first few years, a longer time is required to grow trees by this method than by any other. Trees grown from seed seldom produce fruit in less than eight years, and the plants must be at least two years old before they can be budded or grafted.

Olive seedling plant, 1 year old. (Reduced one half.)

Those intending to plant pits should carefully select those from varieties having perfect kernels. It is not necessary that the variety from which the pits are taken for planting be one possessing high qualities for pickles or oil, because all fruits when grown from seed have a tendency to revert to the wild type, or become of a modified type, entirely distinct from the parent tree; but it is important that the tree be of a thrifty sort. Seed from dwarf trees should be avoided, as they produce plants of a still smaller habit.

The seeds, having been freed from the pulp, are washed in water containing some lye or ashes, to remove all the oil adhering to them; they are then washed in clear water, and, after drying in the shade, are mixed with moist sand and kept in a moistened condition till spring, to be then sown. The use of lye is necessary to render the shell of the pit a little less compact, in order that it may be penetrated by moisture. The lye roughens the shell and thus gives access to humidity.

The sowing is done in February or March. As olive seeds do not all germinate the first year of sowing, it is advisable not to destroy the seed-bed until the end of the second year. Olive pits often continue to germinate in certain quantities for over two years. In order to hasten germination pits may be advantageously split by use of an iron vise. The longer part of the pit is placed between the jaws of the vise, and by turning the screw the shell is split. It is not necessary to take out the kernel; on the contrary, it is better to leave it in the cracked shell.

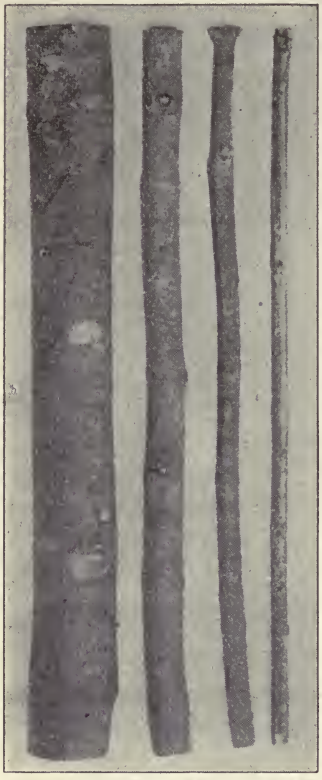
The seeds are sown in ordinary seed-boxes, with bottoms perforated to admit of good drainage. The boxes are then filled with fine earth (sandy loam) to within three inches of the top; the kernels are spread on top of this and covered with one

YOUNG SEEDLING OLIVE PLANTS,

Of Spontaneous Germination, from Seed of Fallen Fruit, Under Orchard Trees.

inch of sand. The boxes are kept moist and shaded for awhile. This method obviates the necessity of soaking the pits in lye to deprive them of their oily coverings, and a person can easily prepare some six hundred or more kernels in a day.

Large Cuttings.—The olive "takes" readily from cuttings. The cuttings preferred are those taken from mature trees and are made from twelve to fourteen inches long, of two-year old wood, or older, and from one to one and one half inches in diameter. They are taken from the trees in December or January, and trenched in some convenient place, preferably in the shade, where they are kept till the middle of February or the middle of March, or later, when they are planted in nursery rows. The ground is thoroughly prepared. The cuttings are planted from twelve to thirty inches apart, and about ten to twelve inches deep. The soil is hoed toward them on both sides, leaving the cuttings covered to within an inch or two of the top, in the center of a ridge. The loose soil around the top protects the cuttings from being scorched by the sun. As the cuttings begin to grow, the shoots put forth through the loose soil and are not disturbed. They are allowed to grow for one season without pruning. The removal of the growth the first season gives the cuttings a shock that prevents the formation and growth of the roots. Many growers plant cuttings at an angle of about forty-five degrees. The season following all shoots and growth are removed, except one which is to form the tree. This one is carefully trimmed, and a stake is driven close to it, to which it is tied.



Cuttings of different sizes, prepared for planting—reduced.

THE DIFFERENT FORMS OF GROWING OLIVES FROM SMALL CUTTINGS—(Reduced One Half).

The portion of the cutting above the apex of the shoot is cut away, and the wound covered with either grafting wax or rubber paint. The cuttings are kept in the nursery as long as the grower chooses, giving them careful attention, when they are taken up and planted in orchard form.

*"We plant the cuttings fourteen inches long and from one inch in diameter up to two and a half inches, six or eight inches apart in the nursery row, and the rows five or six feet apart. We also make cuttings three quarters of an inch; these cuttings we plant in the field where the tree is to grow permanently. We plant diagonally—that is, the top to the north—to keep the sunlight as much as possible from cracking open the limb that is exposed. We put the cuttings about ten inches deep at the foot. The cuttings are taken from the trees just as soon as we pick the crop."

Small Cuttings.—This method is in all respects similar to the "tip" system, except that the cuttings are made from small branches. The branches must be well matured; they are cut into pieces, each containing at least six leaves. The lower leaves are removed, as in the "tip" method, and the upper

Small cuttings—reduced one half.

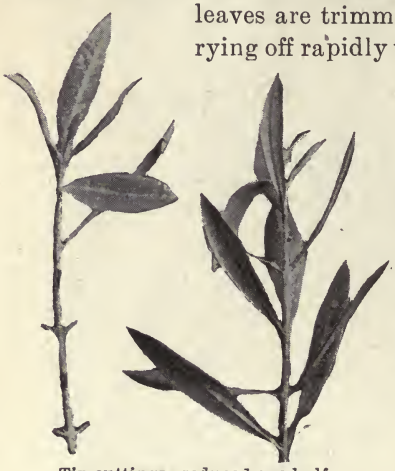
ones trimmed off, as per illustrations. Both ends are cut off close with a sharp knife, as a clean cut hastens callusing and the formation of rootlets. The cuttings are taken from the trees in autumn and winter and are planted in the same manner as in the "tip" method.

*Hon. Ellwood Cooper, Santa Barbara.

ONE-YEAR-OLD OLIVE PLANTS.

Grown from "Tip" Cuttings, Showing Development of Root System. (Reduced.)

From Tips.—The extreme ends or tips of branches are taken from the trees in June, when the trees are in a semi-dormant state, and also in the fall and winter, according to state of the trees, when the growth is in its best condition. The cuttings are made about four to six inches long, as per illustration. These tips are gathered indiscriminately, by cutting them with pruning shears, and taken to a bench, where they are prepared for planting. In their preparation a sharp knife is used. The lower leaves are cut off close to the bud, and the ends of the cuttings are cut obliquely, to within a quarter of an inch of the lower buds. The upper leaves are trimmed to prevent them from carrying off rapidly the fluids by evaporation, and to prolong the life of the cuttings until callused and rootlets are formed. The cuttings are placed close in sand-beds especially prepared or in ordinary propagating-boxes. Propagating-houses with bottom heat are preferred. The following winter they are transplanted into pots or in nursery row.



Tip cuttings—reduced one half.

From Suckers.—Shoots that germinate spontaneously between the roots, at their insertion on the trunk, on the trunk itself, and on the large roots exposed to the sun, are termed "suckers." These suckers when properly developed are turned to advantage for propagation. These shoots are left to grow at will for awhile; then the trunk of the tree is banked up with earth, so as to cause the suckers to take root, which they generally emit at their base. They are pulled off the parent tree in the winter, with a good portion of roots attached; are then trimmed and planted in nursery, and in a season become good trees and fit for orchard planting.

By Layering or Stools.—This is the only system which can be said to be perfectly safe in the propagation of olive trees. There are no risks to be encountered, and in two or

three seasons large trees ready for planting are obtained. For this purpose old stocks are planted, the body being cut off to cause it to throw out numerous shoots, which, when they are of sufficient growth, are turned down and trenched. Growers adopt different modes of treating the shoots in layering them. Some cause the shoot to be partly broken by bending, while others cut an incision, leaving a projecting portion of the shoot on the side that is to remain downward when covered with soil. At any rate, the portion wherever broken or cut soon begins to callus over and to throw out roots. In one or two seasons these shoots are cut from the parent tree, the roots and top trimmed, and are set out either in orchard or in nursery row.

From Sprouts.—The sprouts as they put forth along the body of the tree, which has been cut back so as to force it to throw out numerous shoots, are gouged out, taking as much of the bark and wood as possible. These are planted as in the above methods, and readily take root. The advantage this system has over all others is that these sprouts can be gathered at any time of the year when the trees are growing. This method is closely allied to the "ovule" system of propagation.

SOILS.

A great feature of the olive tree, and one that gives it an important position among the fruit trees of our State, is the fact that it thrives in a greater diversity of soils and locations than most other trees. In the low lands of the valleys it does well; the berries become large and pulpy, and are best suited for pickles. Oil made from fruit grown on trees receiving too much moisture is very hard to clarify. Along the foothills the olive finds a congenial home, producing oil that cannot be excelled. On rocky land, wherever there is soil sufficient to give it a footing, the olive will grow, and with additional care attains perfection. Heavy or damp land is not suitable for it—not that it will not grow on such soils, but because the blossom and the fruit are sensitive to cold and will invariably chill and drop off the tree. The quality of the oil from

injured berries is also affected. The theory for many years advanced, to the effect that the olive would grow and produce bountiful crops on soil too poor to grow anything else, or on soil and in locations where other trees would not grow, has been exploded. While the olive does thrive on rugged soils and in locations where other fruit could not be found profitable, it must not be supposed that it does well under neglect or will not repay care. Careful cultivation and proper fertilization are amply rewarded in increased quantity and superior quality of fruit.

Analyses made of the ashes of the wood, leaves, and fruit of the olive give the following results:

	Wood.	Leaves.	Fruit.
Potash	20.60	24.81	54.03
Lime	63.02	56.18	15.72
Magnesia	2.31	5.18	4.38
Sulphuric acid	3.09	3.01	1.19
Silica	3.82	3.75	5.58
Phosphoric acid	4.77	3.24	7.30
Phosphate of iron	1.39	1.07	2.24
Chloride of potassium	1.00	2.76	9.56
Totals	100.00	100.00	100.00

It will be seen from this analysis that the wood and leaves carry a very large proportion of lime, while in the berries potash predominates greatly. From this it will naturally be inferred that soil suitable for the olive should be heavily impregnated with these elements, or, being absent, they will have to be supplied.

The olive will not do well in poorly drained soil, for while it requires a proper amount of moisture, the tree cannot thrive with its roots in standing water.

To summarize, the olive will do best in a soft, friable soil, moderately warm and moist, carrying an abundance of lime and potash. These conditions are furnished throughout a greater portion of California, where also can be found the climatic conditions required by it.

Preparation of the Soil.—Thorough preparation of the soil for the olive should be the rule, and it should be borne in mind that, so far as the planting of the orchard is concerned, it is done forever. When the young tree is transferred to the orchard it receives a shock, to recover from which it requires

the most tender care. If planted on land which has been well prepared for it—well loosened, properly aërated, and thoroughly pulverized—the young rootlets find no difficulty in the way of their extension, and the tree soon recovers and makes a vigorous growth. If, on the other hand, the land has been merely skimmed over with the plow and the subsoil left untouched, the young roots are checked in their growth, and the trees receive a setback from which they seldom recover. The first year of its life in the orchard determines the whole future of the tree, and whether it shall be a success or a failure depends largely upon the preparation of the land for its reception.

Cultivation.—The application of suitable fertilizers at proper times is an important factor in successful olive culture. The fertilizers should be selected with a view to the requirements of the tree, as indicated by the analyses of fruit, wood, and leaf, given elsewhere. While the olive rejoices in the natural looseness of sandy, gravelly, and stony soils, and in freedom from standing water, it is not of the class of trees that do best in sterile soils. Nutriment is necessary to its productiveness, and if this does not exist naturally in the soil, or has been exhausted, it must be supplied. In growing olives, as with all other crops, the continuous cropping of the soil will gradually exhaust it of the constituent elements of the plant, and these must be supplied from some source. Anything that can be used to enrich the soil is valuable. The orchard should be kept free from weeds, which sap the soil of its moisture, and the surface of the ground should be kept well pulverized.

*"I need not say to any horticulturist that cultivation cannot be too thorough; good tilth is an exhibition of 'faith and work,' which comes very near being an absolute guarantee of success. But even this will not in *all* places succeed without another artificial help, viz, *water*, for it is the exception and not the rule where olive trees will do their best without irrigation; and wherever nearly perfect conditions do not naturally exist, and irrigation is resorted to to establish such conditions, it has become nearly or quite an established fact that for each

*Hon. Frank A. Kimball, of National City.

dollar so expended at least ten dollars may be expected in increased growth and quantity of fruit.

"When taken from the nursery (at two years from planting of cutting), planted in orchard and properly cared for, the olive tree should pay all expenses of cultivation the third year. There are instances on record where cuttings planted in orchard have produced sufficient fruit the third year to pay all expenses of cultivation for that year; but this is not a safe basis for calculation, for it is only with *large* cuttings, taken from vigorous trees, and planted in a voluptuous soil and under the most favorable conditions, that such a result may be obtained.

"In selecting a location for an olive plantation, great care should be taken to secure a well-drained tract, for there is no one thing which will so militate against success as a close, clayey soil with imperfect drainage.

"Exposure also cuts an important figure in the profits to be derived from an olive orchard. A southern exposure hastens maturity of the fruit, and it must always be kept in mind that when the olive approaches ripeness it must be gathered, if first quality of oil be expected; true, the quantity of oil is much less, but the quality is much finer than that pressed from fully matured fruit. A northerly exposure will prolong the period of ripening many weeks; so, by selecting land having both a northerly and a southerly exposure, a person, by his own labor, can harvest at least one half more fruit than if either one of the exposures were selected. It is often said that any kind of soil is good enough for olive trees, and inferentially that the poorer the soil the more profitable the crop. If this be so, it is contrary to all other efforts of nature of which I have any knowledge; but it is *not* so. But it *is* a substantial fact, however, that an olive orchard which has long been cropped, poorly cultivated, and not fertilized, will make a record for unprofitableness which the owner may not long disregard. In such cases, generous fertilizing and good cultivation will cause a response which cannot be mistaken. Good location and good soil are two elements which will act as large factors in successful olive-growing.

"We labor under peculiar conditions in California. As a rule, we do not care to see a drop of rain from the first of May to the first of December. During what is termed the 'rainy season,' and after any considerable fall of rain, the ground

should be thoroughly 'cultivated,' or plowed and harrowed; and after the 'rainy season' is over, the surface of the ground should be well stirred at least once each month, so that it may be in perfect condition to absorb atmospheric moisture during the 'dry season' and be all ready for the first rain of the succeeding 'rainy season.' Two purposes are thus accomplished: the land is kept in good tilth, and no weeds can raise their unsightly and unprofitable heads."

OLIVES IN POOR SOILS.

When olive culture was in its incipiency almost every one contemplating going into the business sought information from "him that knew," and was ever ready to follow his advice. The advice, then so freely given, that "the olive should be planted on soils where no other tree would grow," was followed to a considerable extent; but now all regret it, as that advice proved to be erroneous and misleading, and caused the financial ruin of many who took it. The olive, as do other trees, requires the best conditions of climate, soil, etc., and without these, paying returns from the tree cannot be expected. None of the orchards that were planted in locations where hardly anything else would grow, as was advised, have as yet produced fruit to pay for their cultivation, and in most instances have not produced fruit enough to pay for the gathering; but where the trees have been given renewed attention by way of pruning, irrigation, fertilization, etc., they have invariably responded by producing bountiful crops. In many sections trees planted on poor soils were unable to withstand the drought of the past two seasons. They shed their foliage and the limbs died back, as shown in the accompanying illustration (p. 24).

There are lands, especially in the coast regions, that retain their moisture, which by thorough cultivation do not require to be irrigated. To soils that are not retentive, in which olive orchards have been planted, by advice that the tree would grow and thrive without irrigation, these remarks apply.

In 1893 the writer gave to the public the result of experiments to develop large olives by frequent irrigation. No sooner was mention made by the public press of the results attained than criticisms began to appear against irrigation, based on the theory that the tree did not require it. Specimens of fruit taken from young trees grown without irrigation were brought to meetings. The writer then said that the trees from which the fruit was taken were small and took but little moisture to nourish them, but as they would grow older would cease to bear fruit in paying quantities unless irrigated. What

An orchard planted on poor soil; did not withstand the drought of 1898–9.

was the result? The trees on becoming large, required the necessary moisture to develop their growth, which had now assumed immense proportions. The soil could not furnish the requirements of the trees, and in the summer they lost the larger portion of their leaves. They remained in this semi-dormant condition until the rainy season set in, or moisture in the soil began to rise. Most of the fruit dropped, and what did not fall did not attain a size suitable for pickling. This condition of affairs continued until the growers resolved to apply water. After a season or more of demonstration, they found irrigation to be one of the essential means through which a crop of fruit can be assured.

*"A popular idea is, that if land is not fit for anything else it will do for olives. I do not think so. They have a saying in Italy, 'No manure, no oil.' The reason why we do not get olives is, the trees are *starved*, if want of water can be called starvation. For lack of water the soil cannot furnish the material from which the olive is made. I have seen trees which were able to and did bear fifteen gallons of fine fruit, while fifty feet from them there were other olive trees, of the same size and age, and which bloomed quite as profusely, and in which every physical and natural condition was the same, that did not produce fifteen quarts, I might say, fifteen pints, of olives. Cause, starvation; and I have no doubt, if they had had a proper quantity of water, at the proper time, as the others had, they would have produced as much fruit as the others did. Irrigation without cultivation is quite as unsatisfactory in results as no irrigation. I saw an olive orchard flooded with water; the land was not cultivated afterward, and thus the water was carried off by evaporation, the earth becoming baked and as hard as adobe bricks; result, in August the olives shriveled until they were little larger than the pits should have been, almost no pulp, so little in fact that 188 pounds of fruit were required for a gallon of oil. I do not know of any soil that would not produce a good olive if it had a sufficient quantity of water. This is a solution of the whole question. With facilities for proper irrigation, I would not hesitate to plant any ordinary soil with olive trees, and would expect as a result as many olives as the tree should bear. Nor must it be forgotten that good drainage is quite as important as irrigation. They go 'hand in hand.'"

UNFRUITFULNESS OF THE OLIVE.

The question of the unproductiveness of the olive tree in certain localities is at present agitating the minds of many growers throughout the State; several orchards, although old enough to bear, not yet having given remunerative returns, and others

*Hon. Frank A. Kimball, in Report of Third Olive-Growers' Convention (1893), p. 29.

that bloom profusely but only setting few fruits, being cited as instances. The behavior of the olive in this respect is not new, and has been understood for ages and is due to many causes, but primarily to the improper management of the tree, imperfect bloom, deficient pollen, the ravages of the black scale, propagating from unfruitful sorts, and lastly to weakened fruit buds caused by excessive spraying with strong caustic and crude oily materials, and fumigating with gases too strong for the buds. While spraying and fumigating at times become essential for subduing the black scale, to which the tree is subject, especially in the coast regions or in localities of humid atmospheric conditions, unless used with moderation and applied at the proper time they cause the weakening of the fruit buds and retard their fruiting power. In my investigations I have often found olive-growers spraying either at the wrong time or with materials that not only injured the buds very materially, but had no effect whatever on the insects. Such condition of affairs exists everywhere, and the trees are treated from one to three times a season. Can it be wondered, then, that the trees fail to set their bloom with all these hinderances, rather than being encouraged in healthfulness looking toward a profitable production?

Buds weakened by any cause put forth weak peduncles, which wither and lose hold before the flowers that are attached to them have developed. The flowers also develop unnaturally, lacking fertilizing power, and either wither and fall before fertilization takes place, or never open, thus failing to set fruit.

Trees grown from seed have a tendency to revert to the wild type, or a type entirely distinct, some of which fruit, while others seldom do. The character is also changed by pollen impulse.

There are a great many trees distributed among the missions throughout the State, that, for natural, unexplained causes, have never as yet produced fruit in any quantity, the tendency of the trees being to throw their growth to foliage instead. Many orchardists seeking stock for propagating purposes planted cuttings in large numbers from such shy-bearing trees, and trees grown therefrom have been distributed indiscriminately throughout the State. Such trees have proved a great disappointment, for they have not yet produced fruit to

pay for their culture, and no doubt never will, at least their parents do not.

Almost every variety of olive known to the Old World has been imported into the State and planted indiscriminately before the fruiting qualities were tested or the adaptability to our soil and climate shown. Several of these have not yet produced fruit in any quantity, while others are very shy bearers. Many of these varieties fruit for awhile when the trees are young, but on becoming older seem to degenerate and cease to bear fruit, the branches dying in the center and the energies of the tree being wasted in the production of growth rather than of fruit. Some of these varieties are also deficient in sexual strength of the bloom, not having the fertilizing power essential for the setting of the fruit. For several seasons I have observed in orchards, in many portions of the State, little clusters of berries about half the size of peas. On opening these berries the inside was found to be full of a gumlike substance, and without a pit, showing deficiency in pollen strength. Other berries, about the same size or larger, with pits, being the result of late blooming. In many such trees clusters of dried-up blossoms are often found without any visible pollen in the flowers, which had died for want of fertilization. The behavior in the fruiting of the greater portion of the olive varieties so largely introduced has yet to be studied and experimented upon. That all varieties, irrespective of the climatic and soil conditions of the locations from which imported, planted in a locality with conditions entirely dissimilar, should be expected to become eminently successful, has long ago been proven to be a fallacy.

With regard to the "Mission" olive, its non-bearing behavior is easily understood. It requires, above all things, to be kept in as clean and thrifty condition as possible. The black scale must be freed from it, and the trees must be properly fertilized and cultivated. Once the tree becomes infested with the black scale the smut produced from the excrement of this insect will cover the breathing functions of both leaf and branch, and the tendency of the tree will then be to leaf growth instead of to fruit. The tree, however, may bloom profusely, but, being sensitive to the fungus, the stems to which the flowers are attached become weakened, lose hold, wither, and drop before fertilization takes place. These natural conditions no doubt

also apply with equal force to other varieties. Pruning to encourage the formation of fruit-bearing wood also becomes very essential.

Aside from the causes already mentioned, are the following reasons why the olive fails to produce a crop in paying quantities:

1. Unsuitable soil selection, not naturally well drained, having a strata of "hardpan" or clayey, uncongenial conditions for roots too close to the surface. Soil not of ample richness, of too high or too low altitude.

2. Planting on sites too much exposed, without giving the trees protection by planting others to serve as windbreaks, etc.

3. The existence of a frost line. Frost during blooming period is very detrimental to the setting of the fruit, and in the fall and early winter to the fruit, especially during its tender period or first stages of ripening.

4. Planting varieties of indiscriminate selection, without regard to locality, adaptability, or the suitableness of stocks used, etc.

5. Planting trees too deep or too shallow, which everywhere has proved a grave mistake.

6. Planting too close. Trees, after becoming large, require abundance of soil of which there is not enough for the roots of all. Also, the shade from adjoining trees is very detrimental.

7. Lack of fertilizers—failing to supply the elements of nutrition needed to secure healthy growth of trees, that the particular soil may lack, whether in a virgin state or after the growth of trees has exhausted same.

8. Want of proper pruning, such as the trees may need under varying conditions, especially to encourage fruit-bearing wood.

9. Injudicious cultivation, such as cutting the fibrous roots just before a dry spell, or during blooming time.

10. Want of cultivation, allowing the weeds to grow, when the tree roots should have the soil to themselves, especially in dry weather, or allowing the soil to become dry after plowing, without breaking up the clods and pulverizing the ground.

11. Endeavoring to get two or more crops out of the same ground by growing other plants between and more or less close to the trees, which is detrimental to both.

12. Allowing the trees to become infested with the black

scale, the fungus produced by the excrement of which clogs up the breathing functions of the tree and retards the growth of both tree and fruit.

TRANSPLANTING.

Olive trees are transplanted from the nursery to orchard form in the spring of the year, varying from February to April, according to the climatic conditions of the locality. There are three methods pursued in preparing the trees. One is to take up the tree with the utmost care, trimming all the shoots along the body of the tree to within four or six inches of their base. The tree puts forth new shoots at the apex of those cut back, which in time form a symmetrical top. Another method is to cut the main stock to within twelve or fourteen inches of the ground, so that the tree becomes low-trained in the form of a bush. The third method consists of shaping the tree in the nursery and transplanting it without removing any of the foliage. It is taken up with earth adhering to the roots and is not allowed to grow too large (in the nursery) as the larger the tree the more difficult the operation.

*"In transplanting olive trees from the nursery to the orchard the roots and tops should be protected as much as possible from the sun and wind. The work should not be done when a dry wind is prevailing. The trees should be taken up in as dormant a condition as possible. They are usually in this state in January and February. If it is not convenient to plant them then, they may be taken up before they commence to grow and heeled-in and set out later in the season. At the time of planting, the soil should be settled around the roots with water. The olive tree is very tenacious of life, and may be successfully transplanted at one year of age up to the size of large bearing trees, this having been done often. Although most varieties are apt to grow unshapely in the nursery, they become symmetrical after being out in the orchard two or three years. As some of the roots are cut off in digging, some of the branches should be removed at the time

*John S. Calkins, of Pomona.

of planting; after this but little pruning will be necessary till they begin to bear."

*"In planting an olive orchard, select two or more varieties ripening at different times, which will give more time to harvest and handle the crop. Planters will find it to their advantage to plant two-year-old trees, or older; the roots of the one-year-old trees are too tender and immature to transplant without danger of losing a large percentage of the trees. The utmost care should be observed, from the time the trees are taken from the nursery until they are planted in the orchard, to keep the roots protected from the sunlight and air; never allowing the roots to become dry in transplanting. Because the olive is called a very hardy tree, many planters are careless in transplanting, thereby losing many trees which could have been saved with little care. Too often the nurseryman is censured for the loss. The roots of the olive tree are very sensitive and tender, more so than of any other tree I have ever handled; still, with a very little trouble it can be moved with as little loss as other fruit trees. Often, after planting, the tree will lose all its leaves and remain dormant until the following year; if the bark remains green it will come out all right and do well. The olive is a slow tree to start, but once started it makes a vigorous growth. If part of the top shows signs of withering and dying, it should be cut off, to prevent the sour sap from poisoning the balance of the tree. I have kept olive trees heeled-in for eight and ten weeks, losing very few trees, but this should be done only to hold the trees dormant for late planting. The less handling they can have and the sooner they can be planted after taking from the nursery, the less danger there is from the roots becoming dry, which always occasions loss; but if properly packed they can be safely shipped long distances. The trees should be severely pruned when transplanted. My plan is to cut the main stalk back from a third to a half, according to the height of the tree, and to cut all branches back to three inches, and to plant the tree from six to twelve inches deeper than it was set in the nursery. The most successful olive men plant deep. Deep planting would prove disastrous to fruit trees, but the orchardist will not find it so with the olive, provided he keeps the ground well loosened about the body of the tree. With the short pruning and deep planting,

*F. M. Hunt, of Redlands.

I know many will say there is not much left for show, which is all very true, but I can assure you the result will prove very satisfactory; the per cent of loss will be much less, and at the end of two years they will be far ahead of trees planted shallow with full tops and branches. By this plan I have taken olive trees from the nursery and planted them as late in the season as May, with splendid success. But I would advise planting as early in the season as possible, and when the trees are dormant, January and February being the two best months. By planting early we have the benefit of the winter rains to settle the soil about the roots; settling the soil about the roots with water is better than tramping."

*"In planting a young tree it is better not to disturb any growing limbs or branches, because cutting them when the tree is young interferes with the roots, and the orchardist will understand that if he cuts away the limbs and destroys the leaves he is destroying the breathing apparatus of the roots. An untrimmed olive tree when small and commencing to root will grow four times as fast without pruning than if pruned. The more top it has the faster it will grow, for it feeds largely from the leaves—from moisture. After the second year, though, it must be pruned. Those who cultivate the young tree up to five and a half or six feet must, of course, pinch off all the branches that are making wood rapidly, so as to force the strength into one main trunk. When lateral limbs branch out pinch them off at the end and stop the growth, but all small branches should be left alone as much as possible until the tree gets eight or ten feet high, and then commence cutting them off. Those who want to prune low should start the trees out from four to six inches from the ground and form four or five main branches instead of one. I am not in favor of low pruning of the olive in the coast counties. We have no fear of the sunlight burning the bark. In ten years high pruning will give twice as much tree as low pruning. It grows up to a bush more than a tree, and these shoots vie with each other to get up to sunlight. If the planter pinches them off up to four or five feet he can form a much better tree."

*Hon. Ellwood Cooper, of Santa Barbara.

PRUNING.

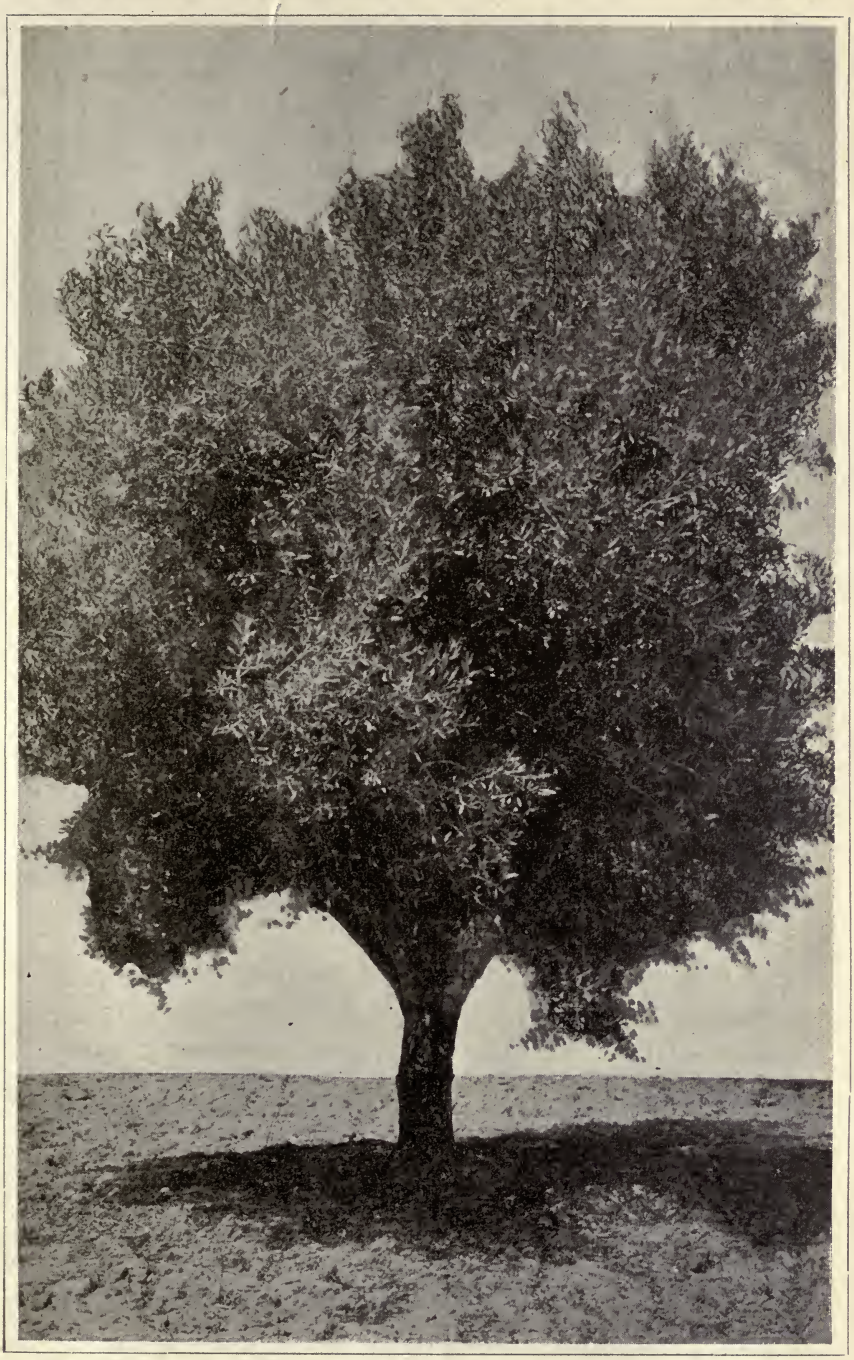
There are in vogue in this State various systems of pruning the olive, each differing materially as to the variety and as to the shape of the tree, but all with the one object in view, *i. e.*, the increase of growth and production. Each system requires study, and it depends a great deal upon circumstances. After the formation of the tree, the chief thing to consider is that the fruit is borne only on two-year-old branches, which, when they have once produced fruit, never do so again. Trees are liable to suffer by injudicious pruning of fruit-bearing branches or by excessive lopping. Therefore, pruning must consist in cutting away the superfluous and useless growth and dead wood to give light and air and make room for fresh and fruitful twigs and shoots.

FORMS OF TREE PRUNING.

Natural Habit.—This form consists of leaving the tree to take its natural form, and to obtain well-balanced trees their formation begins at planting. The trees are not shorn of their top, but it is allowed to grow and become the leader, which with the side or lateral branches soon form a symmetrical tree. The trees are carefully thinned. Branches on the outside extending beyond the symmetry of the main foliage are pinched back during the growing period. Limbs too heavily weighted with fruit are either propped with poles or tied to the main branches to prevent them from breaking.

The olive has a tendency to grow downward, that is, the lower and side branches droop, protecting its trunk from sunburn and the soil beneath from drying out. These may be removed every year, but the trees continue to throw out growth from the side and lower branches every year, which in a short period of time droop, seemingly knowing the tree's requirements. It is nature's system and cannot be changed by man.

Before the introduction of parasitical and predaceous insects, Hon. Ellwood Cooper wrote: "In the pruning during the first years, have only the one object in view, that is, to force all the woody growth into one main trunk. This being done the tree will naturally form a beautiful shape. The cultivator must



OLIVE TREE PRUNED BY THE SYSTEM ADOPTED BY HON. ELLWOOD COOPER, AT ELWOOD, NEAR SANTA BARBARA.

not look at the tree of to-day or to-morrow, but at the tree of ten years hence. All branches to the height of five to five and a half feet should be removed, so as to admit of close cultivating by horses. Trees planted at the distance of twenty feet and well kept, will in ten years touch each other. When this condition is reached they will be in full bearing and therefore will require constant pruning or cutting back. It is much easier and less expensive to gather the fruit from small trees; besides, if the pruning is intelligently done it will improve the fruit and secure a greater quantity to the acre than can be produced under any other conditions."

Olive orchard scene, showing Mr. Cooper's present method of pruning.

Circumstances often revolutionize ideas and change methods; he now says: *"I have changed my method of pruning within the past two or three years; formerly I pruned very heavily. The olive tree grows so rapidly on my place that if I did not prune heavily I would have no tree; but since the State Board of Horticulture and the fruit men of California have interested themselves in parasitic insects, and have sent Professor Koebele on the two voyages to Australia to look for parasitic insects to keep the black scale in check, I find the pruning will have to undergo a very great change. In order to insure the rapid

*Hon. Ellwood Cooper, Report of Third Olive-Growers' Convention (1893), pp. 30-31.

increase of these ladybirds which have been imported from Australia, and which we hope will do the work, it will be necessary to have a large amount of brush near the ground, and the question is which is better, to promote the increase of the ladybirds that are going to keep the black scale in check, or scientific pruning of the trees? I cut the top of the tree back, but I am now cultivating brush. I want it to hang down on the ground so as to absolutely preserve the eggs that are laid by the ladybirds, and also to protect the early stages of the larvæ. This is necessary. If there are many birds they pick the ladybirds and carry them off, and that will defeat the object; so that now I am not pruning an olive tree as it should be pruned, but am pruning it to preserve the parasitic insects that will keep the tree clean. I hope to avoid the expense of spraying.* If this can be accomplished, certainly we can produce olive oil at least one third less, or perhaps at fifty per cent of the present cost. The great trouble with me has been with kerosene oil—ordering it by the carloads from Cleveland, Ohio, and washing, washing, continually. It is very expensive, and so long as the present method of spraying trees is kept up, as a matter of course the more pruning, the more sunlight, the more air the tree is given the easier it is to keep the black scale in check and secure a crop. But with the parasitic insect, with the different kinds of ladybirds, this brush is wanted near the ground to protect them—not pruning olive trees, but cultivating ladybirds. I have changed my method."

Question: "Do you cut the trees back?"

"Yes, every year."

Question: "At what time do you cut them?"

"I cut them all the time."

Question: "How high do you keep your trees generally?"

"The trees that were pruned formerly were not cut back; they are thirty feet high."

Question: "How high would you keep them?"

"I had hoped to keep them at twenty feet, but doubt whether it can be done. I commence when they are not more than ten feet and clip off; always a little higher each time."

Question: "Does this cause them to grow like a willow?"

"The Mission is a very symmetrical tree. It grows into a

*Since then the ladybird *Rhizobius ventralis* has practically exterminated the black scale in his orchards.

main stem with lateral branches, and also with branches diagonal to the main stem, and it is very easy to prune to make a symmetrical tree. But as I said before, I am cultivating the lateral branches to hang down on the ground as a harbor for ladybirds."

Question: "Do you recommend the thinning out of the brush?"

"Yes. The tendency of the Mission olive on my place is to grow very rapidly, and when limbs are full of fruit bend downward, and you will find that one of the things you have to avoid is not to allow these limbs to bear down."

Question: "Do you sucker your trees?"

"Always, except when very young. When we first plant the tree we are very careful not to break anything off, because the leaves of the tree are the lungs, and if you keep cutting all the time before the tree is properly rooted it will not make roots. The more brush and leaves you have, the more rapidly will the roots grow, until the second year; then we begin to cut away."

Question: "With trees three, five, or six years old?"

"About twice a year we sucker our trees."

Question: "In planting an olive tree do you cut it back very heavily?"

"Cut it all away to the cane. In no case do I allow it more than four or five feet of height. Make it exactly like a walking stick—no leaves or branches."

Method Applicable to the San Joaquin Valley.*—"The trees before leaving the nursery should have all the lateral branches shortened in from one to two inches and the top should be cut back, as this prevents the evaporation of sap through the foliage, and there is consequently very little lost in transplanting. The best time to transplant olives is when they are in the growing condition, from March 1st to May 1st, as they then suffer but a very slight setback, will thrive much better, and the percentage of loss will be much less than if taken up in the dormant state. After planting, the trees should be cut back to within sixteen or twenty inches from the ground, or wherever it is desired that the head shall be formed. and in the first year all growth starting close to the ground or on the body of the tree should be allowed to remain, as it

*George C. Roeding, before Fresno Farmers' Club, 1897.

prevents the stem from sunburning and promotes root growth. The following year all this growth should be removed, except four or five branches properly distributed at the point where the head is to be formed, and these should be shortened in to within six or eight inches of the body of the tree. The year after, these branches, in turn, should be shortened in at least one half, and should any new branches have started from the main body they should be removed. This shortening-in method will cause the stem and body of the tree to become strong and stocky, so that when the tree is old enough to bear fruit it will not break down or require support to prevent the branches from breaking off. The natural tendency of nearly all the olives is to shoot upward, like a poplar, and unless this method of shortening-in is carefully followed every year, it is only a question of a short time when all the fruit will be on the top of the tree. It must be borne in mind that pruning is just as essential to the olive as to the peach or pear, for the shortening-in of the branches promotes young growth throughout the entire tree, and the fruit is evenly distributed and is not all on the top. If not pruned, an olive will come into bearing in three years in this valley, but the vitality of the tree will be greatly impaired and when old enough to produce a full crop it will fail to do so."

Vase or Goblet Form.—In districts along the coast and in the bay counties, where fogs and cool atmospheric conditions prevail, especially during ripening time, the "vase" or "goblet" form of pruning the olive is becoming more popular every year. The position of an olive grove in relation to the sun appears to be of great importance, for growers have experienced that by pruning the olive in this form, opening the top of the tree thoroughly to the sun, the fruit matures more evenly and earlier. The tree is well hollowed

Tree pruned by the vase or goblet form in orchard of E. E. Goodrich, Santa Clara.

out to admit air and light, but with careful study as to wood required for crops of the two following years. The lower and drooping branches are allowed to grow downward, even if they touch the ground, for these branches are the most fruitful, and more easily reached during harvest time, thereby facilitating gathering.

GRAFTING AND BUDDING.

The olive is grafted and budded very successfully, during the different periods of growth. The purpose and action of the graft and bud are:

An old olive tree grafted over; grafts growing.

(*a*) To multiply the varieties selected on trees already constituted or on vigorous subjects;

(*b*) To further the wild or semi-wild stocks;

(*c*) To excite the development of the branches, blossoms, and fruits on the parts of the plant lacking them;

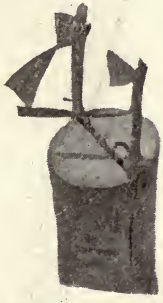
(*d*) To reinvigorate ailing trees by grafting or budding them with others of greater fertility, and to make others more resistant to frosts by grafting them with hardier sorts.

Budding or grafting exercises an influence in several ways: On the stature and durability of the tree, on its fruitfulness, on the size and flavor of its fruits, and on the precocity of fructification. It also modifies its development and sometimes also its duration, making it larger or smaller, long or short lived.

GRAFTING THE OLIVE.

Cleft Graft.—Large limbs are cut horizontally and split from side to side to insert the cions. The common practice has been to split the limb down the center, but of late it has been found that the grafts take better when the cleft is made to one side. When limbs split too far, it leaves the grafts in a loosened condition above.

The method has been improved upon by making the cleft to one side, or on both sides, of the central pith of the limb, as shown in the accompanying cut. In this method the grafts are held more firmly than in the former. It has the advantage also that more than two grafts can be inserted in the limb. This is quite important, because when a greater number are inserted with the same amount of labor, the chances for



Cleft grafts inserted in the center of a large limb, ready to be tied and waxed.

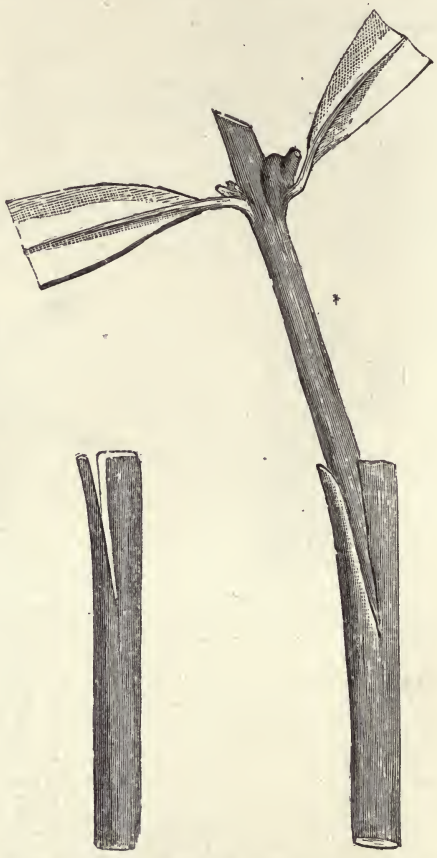
Cleft grafts inserted on both sides of the central pith of the limb.

success are better, and insures a more uniform growth of grafts. After the grafts have put forth growth all are removed except one, the strongest, which now assumes the functions of the top.

Branches of medium size are cut off obliquely, when with a steady hand a vertical cleft is made, the slit being nearly one third less in length than that of the wedge or cion. The cion is next inserted from the top, the cleft being extended with the knife until the wedge of the cion is wholly inserted. It is then bound with strips of cloth, or tied with heavy budding twine, and waxed over. The cleft throughout the whole diameter of the stock is made with a chisel specially made for grafting. When the cleft is two-thirds open the chisel is

leaned against one side to keep the slit half closed and open it sufficiently to insert the cions one after the other. It is always best to graft the branches intended to form the tree, leaving all the side branches undisturbed, as they force the sap into those cut off and holding the grafts. When the grafts have become strong and able to perform the functions of the top, these side branches are removed.

Cleft graft and stock, prepared ready for insertion.



Cleft graft inserted in stock, ready to be tied and waxed.

Cleft Graft, for Small Stocks.—In this method of grafting the cleft is *not* made in the center. The cleft is made from either side, as shown in accompanying figures. The cion is cut from both sides, to be large at the surface side and thin at the inner; then it is inserted into the cleft in the stock.

The cion is driven down as far as it will go, and is made to fit exactly (both barks to be even) on the surface side; the other side does not matter, as the union of the cion and stock is on the surface side. In time both sides heal over. After the cion is inserted it must be tied and waxed, and if the operation is performed low it must be covered up with earth, leaving as little of the cion exposed as possible. The entire leaves on the cions must not be cut off; at least one third of the leaf must be left, to prevent them from drying before they have time to unite with the stock. Also, the entire leaf must not be allowed to remain on the cion; the trimming of the same prevents it from carrying off too rapidly the fluids by evaporation. In this method great care must be exercised in making the cleft. A cleft made in the center of the stock generally causes the stock to split too far at the time the cion is inserted, and it is difficult to get a perfect fit. The more the cion is pushed down into the cleft the more the stock will split; this often results in the loss of the entire tree.

The best time to graft the olive is when the trees commence to put forth new growth in the spring, through the summer months, and late in the fall when they are commencing to relax in growth.

Crown Grafting.—Crown grafting is practiced, from February to April, according to locality, when the trees are in sap and the bark can be easily detached. The stocks must be cleanly cut off thirty days before. When the time of grafting has come the wounds are revived with the pruning knife and the dry portion is taken off. This mode of grafting is suitable for trees of average and of large size; for the latter it is even necessary, because it permits the insertion of several cions in proportion to the vigor of the stock itself. The cion is made about two to four inches in length. The higher portion has two or three buds, and the cut of the lower end is made obliquely, like a flattened wedge. The wedge must begin in front of a bud, starting from the medular sheath and ending by continually thinning in an acute form. Being thus deprived of the pith, it adheres better to the stock; it must have, therefore, but little thickness. The insertion is made on top of the stock, in a cut between the bark and the wood. To facilitate the entering of the cion its point is either sharpened or

moistened when inserted into the stock. When several cions are to be inserted into large branches they must be placed a good distance apart. The insertion being made, the parts are wrapped with cloth or twine. Then grafting wax is spread on the wounds, on the cuts and on the bark corresponding with the inserted cions, so as to prevent laceration.

By making the crown grafting near the ground as much as possible, both the cion and the stock can be covered with earth as far as the higher buds. In this manner, the success is more certain and the development more prompt, as the drying up of the parts is prevented and the development of roots from the incisions facilitated.

When only one cion is to be inserted into the plant, the success of the grafting is more certain if the stocks are cut off obliquely and the corresponding end of the branch hewed to a wedge, beginning with a small tongue at an acute angle. This tongue is necessary to make an exact joint with the oblique surface of the stock.

Indoor Grafting.—This method, as illustrated in figures on page 43, is practiced mostly indoor, in the greenhouse or under frames. The stock is not entirely cut off, as shown in the illustration, but about half of the foliage is removed. The operation is performed by cutting into the stock, simply pressing the knife slightly, so that when the cut above is made it will form at the lower part a cut in the shape of a V. This cut is made directly over a bud (a leaf) on the stock. This has the tendency of drawing to the graft nutritious sap, which keeps it alive, and aids it in uniting with the stock. The graft is then trimmed, leaving to it about one third of the leaves, as shown in the illustration, and inserted in the stock. Care must be taken that both barks fit exactly on one side; the other side does not matter, as it heals over in time. The graft may be waxed, if the operator so desires, but it is immaterial, unless under low heat or no heat at all. After the graft has started, the stock above the bud is cut back, when the tree may be removed to the open air or planted in nursery.

Grafting in Localities of Dry Atmospheric Conditions.*—"From my experience in grafting olives, in the Fresno district, I consider February the best month, as I have experimented

*George C. Roeding, of Fresno.

from that month on up to the first of May, and have met with the best success with the grafts put in in the month above stated. The cions should be cut when the grafting is to be done, and nothing smaller than a cion the size of a lead pencil should be used. In grafting over large trees we use the cleft

Prepared cion and stock of an indoor graft.

Indoor graft, showing growth.

Cion of indoor graft inserted in stock ready to be tied.

graft. Great care should be taken in waxing, and, in addition to the liquid wax, which should be carefully spread over the top of the branch which has been worked, and around the side where the split has been made, thin cloth should be wrapped carefully around the top, as well as around the branch where

the split has been made, and this should also be waxed over. The object in view in doing this is to take every precaution to keep the air out. One very important point that should be observed in grafting over old trees is not to cut off all the branches of the tree, but leave one or two to carry off the sap, which must find an outlet. The branch or branches which remain should not be removed entirely the next year, but should gradually be cut back and should only be cut away after the grafts have attained some size, and it will probably take at least two years before it will be perfectly safe to remove all that remains of the original tree. In some localities, especially in the coast counties, I have seen the entire tops of old olive trees cut away and grafted, and the trees live; and here I have seen the same experiment tried, and, with very few exceptions, the trees so handled died. The cause of this is probably to be attributed to the difference in climatic conditions in the two localities. I believe, however, that it is always better in grafting over trees, whether they are deciduous or evergreen, to allow at least one branch of the original tree to remain until the grafts have attained such a size as to take the place, to a certain extent, of the original top, which has been removed. There is no question in my mind that in removing an entire top of a tree, so as to prevent the circulation of the sap, it is a terrible shock to it, and if the tree does finally recover it takes several years to do so."

BUDDING THE OLIVE.

Budding olive trees by the ordinary methods practiced on fruit trees is somewhat difficult. The buds being small and the bark thin, great care is necessary in order to insure success. The methods herein described, while somewhat new in use, have given the best results.

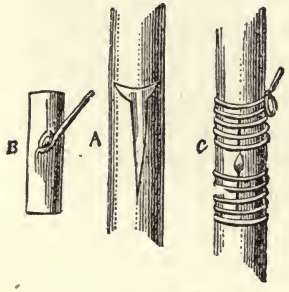
Plate, or Eye, Bud.—This is one of the simplest of all methods and is employed on large as well as small trees. The operation is performed in the spring and through the summer, or in the fall. Buds put in in the spring start early; those in the fall are left to lie dormant through the winter. An incision is made on the stock, thus ┌┐, and the flap drawn down. The bud is then cut from the cion to be a trifle smaller than the

space cut in the stock; it is then inserted, as shown in the figure. The flap is then turned up, covering the bud entirely, and tied tightly with soft cotton twine. The bud consists of only an eye and the bark which surrounds it. At every leaf there is a bud, which on being cut from the stem very easily separates from the wood. At three weeks or so the strings are removed. The top of the tree is then cut off gradually to induce the bud to start, or the tree may be girdled about an inch or two above the bud. When the bud has made a good start, and has become strong, the entire top of the tree is cut away a foot or so above the bud, and the bud tied to the stock. As soon as the bud has assumed the functions of the top, and no longer needs support, the remaining portion of the top is cut away and the cut made is waxed over.

Plate bud, front view.

Plate bud in place, side view.

Ordinary Plate Bud.—This method does not differ materially from the shield method hereinafter described, or methods practiced on other trees, as can best be judged by the accompanying illustration. The incision in the stock is made in the regular way. The bud is cut from the limb, the leaf having been previously trimmed off, leaving about half an inch of the stem attached to the bud for protection of the eye in handling. It is then tied.



A. Incision in the stock.
B. Plate bud.
C. Bud inserted and tied.

Double Flap Bud.—This method is identical with the plate bud, except that the incision in the stock is made in the form of an H. The flaps are drawn both ways, up and down, from the center incision; the bud is then inserted, as shown in the figure, and tied. These flaps protect both ends of the bud. In this method buds having a large bulge at the leaf part can be used.

Double flap bud, in place.

Ring Budding.—The cion for ring budding must have one or more buds, and be at least two and one fourth inches in

length. Having made a vertical incision in it with the grafting knife, the bud is carefully detached with the knife from the underlying alburnum, and stuck into the stock, which has been deprived of an equal tube of bark. In making the insertion care must be taken that the bud of the ring be close below a bud of the stock, in order that the latter may draw the sap toward the cion, thus insuring its development. Should the cion be of greater diameter than the stock, it must be reduced in size accordingly; if, on the contrary, a portion of the stock remains uncovered after the application of the graft, a piece of bark may be added to fill the empty space. Lastly, the ligature is made.

Ring Budding with Cortical Ribbons.—In ring budding with cortical ribbons, the cion is prepared as in the preceding case, but the bark of the stock is cut into ribbons, folded downward. The ring being applied, the cortical ribbons are drawn up over it and the whole kept in place by a proper ligature.

Shield Budding.—Shield budding can be practiced from March to September. If made in summer the shield is taken from a medium-sized branch of the year's growth; if made in spring, from a branch of the preceding year. The buds must be well formed and unexpanded, and the branch in sap so that the bark may be removed with the finger. The maturation of the object-bearing branch is recognized by the dark color of the epidermis, by the formation of the terminal bud, by the elasticity of the tissues under the pressure of the fingers. A branch advanced in maturation is preferable to one still herbaceous; the early or too forward branches and those too floriferous are bad object-bearers.

The eyes situated in the middle of the branch are to be preferred for grafts; those near the basis and on the top are often defective, because they are either tender or herbaceous, or too disposed to bear fruits.

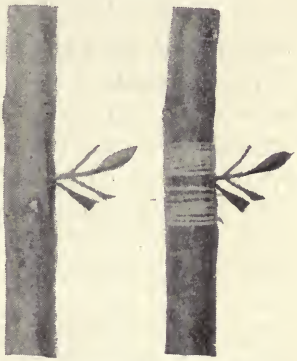
In regard to the stocks they must be in sap to receive the cion, consequently the bark must be easily removable. The stocks must be carefully trimmed of all growth some time before, in order that the course of the humors may not be abruptly arrested at the moment of grafting and the success hazarded.

To extract the shield from the branch two transversal

incisions are made with the grafting knife above and under the bud to be removed, one from one half to three fourths of an inch above the bud, the other about the same below. The knife blade is inserted as far as the sap wood (alburnum), and the shield extracted with a ligneous fragment, in which is the basis of the bud. The alburnum adhering to the extremities of the shield may be skillfully removed if the stocks are not much in sap. The shield can also be extracted by making three incisions in the bark of the branch in the form of a triangle; that is, one transversely over the bud and two in the form of a V, starting from and terminating under it in an acute angle.

Before detaching the shield, two incisions in the form of a T are made in the bark of the stock, dilating the borders of the wound with the grafting knife; then, holding it by the pedicel, the shield is detached and with the aid of the knife inserted through the slits, pressing it quickly with the fingers at the same time, so that it will fit exactly the alburnum of the stock and be covered with its bark, the bud excepted. This being done the ligature is made from above downward, in order to prevent the displacing of the shield.

There are cases when the sap of the stock is abundant and injures the graft. This may be prevented by making the incisions in the stock in the form of ⊥ instead of T. The shield is cut square at the lower end and pointed at the top, leaving the bud, however, in its natural position. The shield having been inserted through the transverse cut of the incision, that is to say from below upward, the ligature is made from the lower part of the wound upward, in order that the shield may not be displaced from its position.



Twig bud inserted in stock—reduced. The same, tied—reduced.

Twig Bud.—This is one of the simplest methods employed on the olive, but requires more care and skill. It has an advantage over all other methods, because the buds never fail to start after they take hold, and again, there are no blind buds, many of which never start and which are greatly encountered in all other

methods of budding. In this method limbs having numerous twigs, from half an inch to two inches long, are used. Each twig is utilized for budding. The twigs are cut deep into the wood, to give the bud sufficient bark. The greater part of the wood in the bud is then carefully removed with the end of the budding knife as shown in the figure. The buds are then inserted and tied in the regular way. The leaves are partly

Twig buds, showing how they are trimmed and removed from the branch. The one on the right shows a twig bud prepared for insertion, the wood in it having been gouged out.

trimmed off, leaving at least a half inch of the leaf on the bud to prevent the bud from drying. This method can be performed at any time of the year when the sap flows freely. Best results are, however, obtained early in the spring of the year, as the operation can be performed to a much better advantage, the buds growing and becoming strong in one season.

VARIETIES.

From a single species there issued, through fecundation, so many varieties of the olive that now their number can hardly be reckoned and it would require a long study to describe them. Such a task would be a most difficult one, inasmuch as a great many of these varieties, through modifications to which they are subject by different conditions of soil and climate and cultivation or by changed locality, possess peculiar characters and habits which might be observed and recognized only through experience.

In many European olive regions it has been observed that many varieties have not maintained themselves permanently, and also many have been introduced under the local names by which they are known in the districts from whence imported, and on fruiting were found to be simply a multiplication of the same under different names.

In selecting varieties of olives the most important question is a knowledge of the characters of the tree, the stature, the precocity, the fruitfulness, the oiliness of the fruit, and adaptability to the location where it is to be planted.

1. The degree of resistance of the fruit to cold and heat, as to whether the tree can thrive in unprotected and non-temperate places, in unpropitious localities, or places having the most favorable exposures and well protected.

2. The bearing of erect and robust or thin branches, numerous or sparingly, suggests the form the trees will have, and the method of pruning to adopt to make them fruitful.

3. Large standard trees, or dwarfs or semi-dwarfs, indicate the area that they will eventually occupy and the proper distance to plant.

4. The degree of precocity in blooming and maturing of the fruit should be known in valuing the fruitfulness of any variety.

5. The percentage of oil that olives of a given weight will produce.

6. Varieties that make a good pickle ripe, or a good quality of oil.

7. Varieties that make a good pickle green, or oil when ripe.

Those who interest themselves enough to make the above research can but feel safe in the outcome of their orchards, and need not be asking "What is the best olive?" a question which, to embody all the essential qualities in one variety, cannot be answered.

THE "MISSION" OLIVE.

Although innumerable olive varieties have been introduced from almost every locality in the world where the olive grows, *no* variety has as yet given such universal satisfaction as the "Mission," and it stands to-day preëminent as the most popular and most profitable variety grown. It has qualities found in no other variety, and is therefore given first place on the list.

Mission, so called, from its first having been grown at the missions and supposed to have been introduced at their advent. It is a remarkable variety and fit for either oil or pickles. There are various types of this so-called "Mission" olive, but the one most universally grown is easily distinguished, being characteristically marked, from all other types and varieties. It is a tree of great longevity, of extraordinarily large dimensions, of thrifty growth, erect, hardy, and well adapted to our climate. It thrives and does well in almost every part of the State. It grows in almost any kind of soil, if well drained. Bark grayish, branches slightly drooping; leaf lanceolate, upper face deep green, smooth, under face greenish ashy white. Fruit elongated, distributed irregularly, isolated or grouped in twos, threes, and clusters, red at first, but deep purple-black when ripe; it carries on its surface numerous white specks, most of which disappear gradually on ripening. Ripens late and unevenly, which is its great drawback, especially in sections where the soil gets very loose after an early rain and is visited by early frosts. Many, however, prefer it on account of its late ripening, as the picking is done in winter after all fruits are gathered, and the growers are independent of high-priced labor.

FRUITING BRANCH OF "MISSION" OLIVE. (REDUCED.)

INTRODUCED VARIETIES.

The following varieties have been introduced into the State and some have been planted to a considerable extent. Those so far as known to the writer are described briefly, with comments:

WILD TYPE—DWARF TREES.

Tree semi-dwarf, very showy, small branches, robust and erect. Fruit of varying size, with very little flesh; valuable for stocks.

SEMI-WILD TYPE—MEDIUM TREES.

Redding Picholine.—The first olive trees imported to this State was in 1872, by the late B. B. Redding, from France. These were of the Picholine variety. On the voyage the tops of the trees froze down below the graft. They were planted in two lots in Sacramento, and most of them grew. The shoots that came up were all from below the graft, and were widely distributed throughout the State for propagating purposes, under the impression that it was the true Picholine. These produced, instead of a large berry, which the Picholine is, a small olive having characteristics of the wild species. In 1888 I named it as above, to distinguish it from the true Picholine, a variety which it does not resemble, in either tree or fruit.

Wild Olive.

The tree is of small dimensions. The fruit is quite small, and of a deep blue-black color. It makes a fair oil, but not of high grade. The oil congeals at a moderately low temperature. It is best suited as a stock to bud and graft upon.

CULTIVATED VARIETIES.

Amellau.—Tree of medium size, strong and regular bearer. Fruit large, oval, pickled green. Ripens early.

Ascolano.—The white olive of Ascoli. Valuable for pickling green.

Atro-rubens.—A vigorous, tall spreading tree. Fruit below medium size, first mottled with red, and deep black when ripe. Skin thin, pulp colored a vinous red. Makes excellent oil, but unfit for pickles. Very sensitive to cold.

Atro-violacea.—Tree vigorous grower and prolific, of a weeping habit. Fruit medium size, deep blue-black. The fruit makes oil of high grade, and also good pickles, either ripe or green. This is the only olive so far known in the State that dries well, the bitter principle entirely disappearing on drying. It ripens early.

Beca Rufa.—Tree of medium size, and moderate bearer. Fruit small, and suitable for oil. Ripens early.

Belmonte.—A beautiful elongated fruit, smaller at the calyx, larger at the blossom end. Deep blue-black. Ripens evenly. Makes good oil, and can be pickled ripe or green. Ripens early.

Columella.—Tree vigorous and prolific. Fruit before ripe of a light golden yellow, turning to wine red, and when ripe dark purple. Makes excellent pickles in the semi-green state, and is quite deficient in bitterness. Makes a fair pickle when ripe. It gives a large per cent of oil, but not of high grade, yet very good for blending. Fruit ripens unevenly, and is very sensitive to frost.

Correggiola.—A vigorous grower and prolific bearer. Makes a very high-grade oil, and with proper pruning can be made to yield a good crop annually. The fruit dries very readily and releases the oil easily under pressure. When grown on hillsides and light soil is liable to rather excessive bitterness, which is at first very noticeable in the oil, but passes away as the oil stands. It does best on rich soils. Ripens in November.

Grossajo.—Tree suitable for light soils. Fruit medium size, ripens unevenly, in November. The oil somewhat "fatty."

Hispania.—Fruit large, very fleshy. Good for pickles in the green state. Ripens in December.

Infrantio.—Fruit medium size; best suited for oil.

Lucques.—Tree of medium size, a shy bearer. Fruit of crescent shape, makes excellent pickles, either ripe or green, and the oil is of highest quality. Ripens early and evenly.

Macrocarpa.—Tree of dwarf habit—a bush—and a shy-bearer. Fruit of extraordinary large size, but deficient in oil, and only fit for pickling green.

Manzanillo.—Fruit large, orange shape, vinous red cast before ripe, changing to deep black, with minute white specks. Tree of large dimensions, and prolific. The fruit makes excellent pickles, either ripe or green, and also an oil of high grade.

Morinello.—Tree medium size, very hardy. Ripens early. Valuable for oil.

Nevadillo Blanco.—Tree of fair size, and suitable only for specially favored localities. Fruit medium, ripens early. Best for oil.

Nigarina.—Tree large and a thrifty grower. Fruit medium, and yields a high-grade oil.

Oblonga.—Tree thrifty, and a regular bearer. Fruit elongated, makes excellent pickles, either green or ripe, and is also valuable for drying. It makes a high-grade oil. Ripens early.

Pendoulier.—Tree handsome, thrifty, drooping in character, very prolific. Fruit large, and very showy. Makes excellent green pickles, and a high-grade oil. Ripens early.

Pendulina.—A handsome, tall tree, and a very good bearer. Fruit medium large, excellent for pickles, either ripe or green. Rich in oil. Ripens evenly and early.

Piangente.—Tree of weeping habit, very prolific. Fruit small, and valuable for oil. Ripens early.

Picholine ("St. Chamas").—Tree large, and a strong grower. Fruit oblong, pickled green. Ripens early.

Polymorpha.—Tree handsome and prolific. Fruit large, makes excellent green pickles, and an oil of fair quality. Ripens early.

Precox.—Tree medium, prolific. Fruit oval, small, purple black, valuable for oil. Ripens early.

Racemi.—Tree of medium size, prolific and hardy. Fruit small, and suitable for oil. Ripens early.

Razzo.—Tree of medium large size, a shy bearer. Fruit small, and suitable for oil. Ripens late.

Regalis.—Tree of medium size. Fruit large, and only suitable for pickles. Ripens late.

Rubra.—Tree of medium size, very prolific. Fruit of medium size, and makes oil of high quality. Although the fruit is small, it makes good pickles. Ripens early.

Salonica.—Tree of medium size, a shy bearer. Fruit large, and suitable for oil. Ripens late.

Santa Catherina.—Tree of medium size. Fruit extra large, and good for pickling green.

Sevillano (Spanish Queen).—Tree strong grower, with spreading branches; requires rich soil. Fruit large, pickled green. Ripens early.

St. Agostino.—Tree of medium size. Fruit green, large, and good for pickling green.

Sweet Olive.—There are two varieties grown, one producing large fruit and the other small berries. The fruit is sweet, without bitterness, and best suited for drying.

Uvaria.—Tree of medium size, vigorous and hardy. Fruit of medium size, dark blue, borne in clusters. Makes a fair oil, and fairly good pickles. Ripens early.

Verdale.—Tree of dwarf habit, a shy bearer, and very sensitive to cold. Fruit is suitable for pickles. Ripens early.

The following is a list of other named varieties:

Ascoli
Attica
Bianchetta
Bella di Spagna
Bellotudo
Carrasqueno
Casalivo
Cajon
Champion
Colchonudo
Columbaro
Cornicabra
Cucca
Dalmatian
Dolce
Empeltre
Favoral
Frantojo
Gargnan
Gentile
Giogliaio
Gordal—(Sevillano)
Gremignolo
Hervaza
Huff's Spanish
Javaluno
Lavaguino
Lechino
Madrileno
Mammolese
Marcherito
Maremmano
Mignolo
Monopolese
Morchiaio
Marajolo
Morinello
Mortino
Mortin
Mortellino
Nigretta
Nocillara
Obliza
Occhino
Ogliaro
Oleastro
Olivastro
Oriolo
Palono
Palazzriolo
Palomino
Patronese
Perugino
Pesci Atino
Piangenti
Pecudo
Pilloro
Pignolo
Picio
Puntarolo
Racimal
Racinoppe
Ragghio
Ragialo
Rastrellino
Redondillo
Rosseldino
Salvatico
Taggiasco
Trillo
Tondo
Varal Blanco
Verdigo

ORNAMENTAL VARIETIES.

Olea Apetala.—Olive without petals, has elliptical oval leaves, quite entire. The flowers, without petals, as its name indicates, are disposed in bunches, and are very beautiful. Native of Holland.

Olea Americana.—Olive tree of America. It is found in the Carolinas and Florida. It is an erect plant, with lanceolate leaves, elliptical, rather oblong, pointed, smooth, entire, solid, glossy on the upper face, and of a fine yellowish-green. It blossoms in June; its flowers are arranged in close bunches; its bracts are persistent, united, and small.

Olea Capensis.—Olive tree of the Cape of Good Hope. Very dwarf and bushy plant, two feet high. Its branches are rough, whitish, tetragon. Leaves opposite, oval, rounded, very large in comparison with those of the European varieties; quite entire, solid, stiff, of a fine dark and gloomy green on the upper face, and pale beneath. It blooms at different times. Small white flowers, disposed in elegant and showy divergent bunches. One variety only, with elliptical wavy leaves and green pendicles, is cultivated.

Olea Emarginata.—Tree grows in India to a height of sixty feet. Branches are opposite, gray, and striated; has the leaves opposite, oval, rounded, notched at the summit, quite entire, solid, wrinkled, of a fine lively green on both faces, the pendicle short and wrinkled. Flowers larger than any other of this species, bell-shaped, in four small divisions, beautifully disposed in terminal bunches.

Olea Exasperata.—Rough olive tree, blooms in May. Originally from the Cape of Good Hope. Bushy plant of about five feet high; erect and dark branches; leaves opposite, oblong, obtuse with a point, quite entire, solid, glabrous, five or six inches long; numerous white flowers in trichotomous and terminal flowery tufts.

Olea Excelsa.—Olive tree of Madeira. Small plant, having an erect, gray, and branching stem; leaves lanceolate, elliptical, pointed and not smooth like the Olea Americana, but with the edges reflected, quite entire, solid, shining, of a dark green color on their upper face. Flowers in dense bunches, the bracts leafy, the flowers cup-shaped and persistent, the higher caducous, large, leafy.

Olea Fragrans.—Odoriferous olive tree from China and Japan. Tree grows from three to six feet, having branches more flexible than those of the other olive trees.

Olea Rubra.—Resembles the Olea fragrans; its leaves are larger and its bearing is also more arborescent, but it produces scanty flowers, and its flowers are very small and do not differ from those of the more common species.

Olea Serratifolia.—Tree with leaves indented like a saw.

There are also the *Olea Chrysophylla*, *Olea Floribunda*, *Olea Arborea*, *Olea Ilicifolia*, *Olea Ferruginea.*

EXTRACTING OLIVE OIL.

*"The mode of extracting oil from the olive, which was practiced thousands of years ago, still obtains, but with machinery better adapted for economical work, steam being substituted for the labor of men and animals. To be able to obtain the largest quantity of oil possible from the olives they must be on the trees till *ripe*, and shriveled—but quantity is at the expense of quality. The finest grade of oil can only be obtained by gathering the fruit while it is yet hard, but sufficiently ripe to allow the pit to be squeezed out without carrying any of the flesh

Olive Crusher at Camulos; first built in the State, aside from the one at San Diego Mission.

*Hon. Frank A. Kimball, of National City.

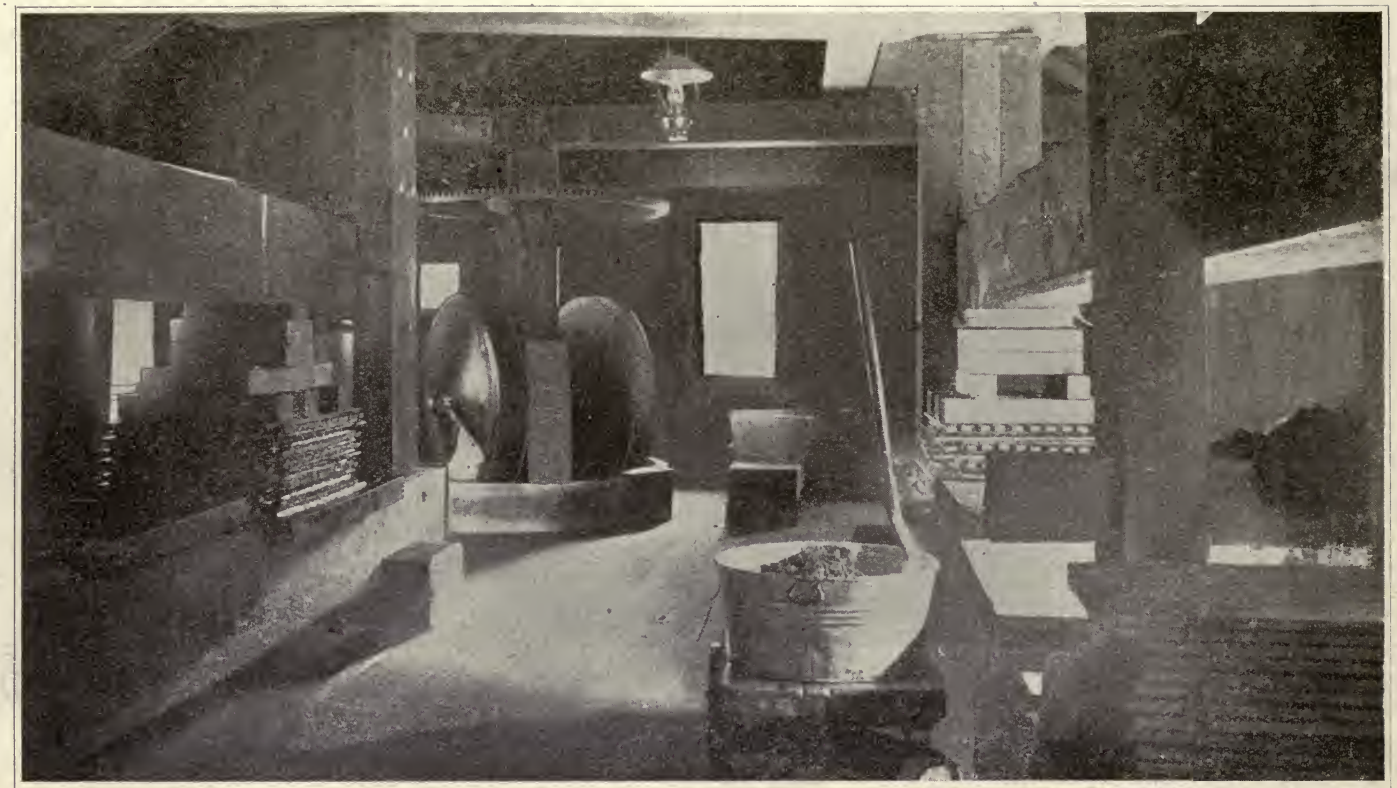
with it. Early in the season the olive may become quite black before this condition is reached, but later, when the weather gets cooler, the olive may be 'ripe' when perfectly 'green.' Immediately after being gathered the olives are spread, one or two inches deep, on trays or racks, which may be placed one above another, leaving space for circulation of air, great care being exercised to prevent them from heating (in which case the oil is spoiled for table use), and when a sufficient quantity of moisture has been evaporated they are ready for the crushing mill, which, with its appurtenances, must be made of materials which cannot absorb odors—metal and stone, as much as possible, being used—and the same care and cleanliness exercised in *making* the oil must be continued until it is in the bottle. After the olives are crushed (which is done under stone or iron rollers that are made to revolve in a large stone or iron basin in which about three hundred and fifty pounds of olives are placed and which constitutes a 'charge'), the pulp is placed in a tub of proper size, made of very narrow staves placed a little distance apart and bound with strong steel hoops which are hinged so that on being opened the pomace may be easily removed, and a light pressure brought to bear on it, and an oil of first quality, or 'virgin olive oil,' is produced. The pomace is then removed and recrushed and again subjected to pressure sufficient to secure a second grade of oil. It may be again crushed, at the same time adding hot water to assist in liberating the remainder of the oil, when a still greater pressure is used. This gives an inferior grade, which is used for light or lubricating. There yet remains some oil in the pomace, which may all be utilized by the soapmaker in the manufacture of castile soap. The residuum is applied as a fertilizer. In the process of pressing the pulp, the fruit juice and oil, with a considerable quantity of pulp, runs from the presses into large tin tanks. The oil gradually rises to the top and is skimmed off and poured into the settling tanks, where it must remain for from sixty to ninety days, when a natural precipitation will have thrown down nearly or quite all foreign matter, and the oil is ready to pass through a filter, which is made by lining a conical bag, made of heavy filtering felt, with several thicknesses of white cotton-batting. It is again filtered through druggist's filtering mats, after which it is ready

OLIVE-CRUSHING STONE AND CONCRETE BASIN.

for bottling. Care in handling olive oil does not cease when it is transferred from the filter to the bottle. It is exceedingly important that *light* be excluded and that it be stored where an even and reasonably cool temperature is secured. When offered for sale only 'sample' bottles should be shown, and these are *not* to be sold. A purchaser should decline to take a bottle of oil which has been placed where the sun's rays or even light has been allowed to reach it. When transferred to the kitchen the bottle should *never* be left uncorked and should be kept in a cool place in the dark."

*"The berries are dried before crushing, as it is necessary to evaporate a portion of the water of vegetation which they contain. If, however, they are left out on the trees until shriveled, which is proof that the necessary evaporation has already taken place, no drying is needed after picking. This late picking is not best. If dried by the sun it requires about fourteen days. This plan cannot be depended upon, excepting in years when the fruit ripens early, and we have continuous sunlight, with moderately warm weather. By artificial heat ranging from 110° to 130°, the drying can be done in less than forty-eight hours. The crushing and pressing should follow without delay; that is, the fruit taken from the drier in the morning should be crushed and pressed the same day. Long intervals or delays in the process from picking the fruit to expressing the oil tend to rancidity. To make perfect oil requires a perfect system in the whole management. The capacity of the press, the crusher, the drier, and the number of pickers should correspond or be about equal. All fruit picked during the day should be in at night, cleaned the following morning, and go into the drier immediately after the previous day's drying is taken out. The heat or temperature of the drier ought to be so graded as to complete the work in forty-eight hours, and it is better that it should be under 130° rather than above. Economy will necessitate in the business a system in the different branches of the process admitting of no delays from the beginning to the end. My drier has a capacity of five hundred square feet of surface, and will contain at one time over two thousand pounds of olives, equal to five pickers of four hundred pounds each per day, and as much as the crusher and press I

*Hon. Ellwood Cooper, of Santa Barbara.



INTERIOR VIEW OF COOPER'S OLIVE OIL WORKS,
AT ELWOOD, NEAR SANTA BARBARA, SHOWING MILL AND BEAM PRESSES.

am now using can work. The almost universal method of crushing the berries is by a heavy stone, similar to a millstone, which is rolled around on the edge in a deep circular groove, or trough, and by its weight does the crushing. A beam passing through the eye of the stone and working on a journal in the center of the circle with a horse attached to the outer end of the beam, is the simplest way to do the work, and the plan that I have adopted. The circumference of the trough depends some-

The Crusher.

what on the size of the stone. The one I am using is four feet high and six inches thick, and the diameter of the trough in which it works is six feet; the length of the beam is fifteen feet. This crusher is amply sufficient for an orchard of one thousand trees. It cost about fifty dollars. A stone five feet in diameter and two feet thick would crush in eight hours a sufficient quantity of berries to make one hundred gallons of oil, and by working it night and day the crop of ten thousand trees. It would be better, however, to have two stones half the thickness

of the above, one following the other in the same groove. The horse should work on the outside of the building containing the crusher. To make one hundred gallons of oil each day would require two good presses. The one best adapted for the purpose, so far as I have seen, is that used for making oleomargarine. Such presses could, with very little expense, be worked by the horse power used for crushing the berries, so that one man could do all the crushing and pressing. The press I am using is an old-fashioned wooden beam press. The beam is twenty-six feet long, and with a large box filled with rock suspended at the extreme end, the power can be increased

The Power House—power operated by horse power from an independent building.

to one hundred and fifty tons. The press with the differential pulleys cost about $150. Such a press cannot be improved upon for expressing the oil, but the additional labor and the time lost in changing are so much greater than would be required for the oleomargarine invention, that the latter would facilitate the work and be cheaper in the end, besides taking up so much less room. The crushed olives are put in the press in cheeses about three feet square and three inches thick, with wooden slats between each cheese. Ten or more cheeses can be put in at each pressing. I use coarse linen cloth to contain the crushed olives. The fluid that is expressed is put in large tanks and left for sixty to ninety days, when the oil will separate, and being lighter will rise to the top, where it can be

drawn off. The pomace after the first pressing is recrushed, and by pouring hot water over it a second quality of oil is expressed. The refuse can then be used for fuel, for feed for pigs, or for making a third quality of oil. If for the latter, it is thrown into vats, boiling water poured over it and left to ferment, when the oil still remaining will be liberated and rise to the top."

*"The Mission olive on my place at El Quito, in Santa Clara County, has always proved very difficult in oil extraction, on account of the amount of solid matter which holds the oil and the water of vegetation together. A great deal has been said about making olive oil with the olives absolutely green, but so far we have not succeeded at El Quito, and with the Mission olive quite ripe on my place it has proved very difficult to separate the oil from this mass. Any one who has made olive oil has probably encountered this difficulty. After the olives are pressed there runs out a mass of olive oil, the water of vegetation, and solid matter. In a little while it settles; the oil remains at the top, and the mixed mass in the center. If the oil cannot be separated in a few hours from this mass it is liable—I do not say it always will, but has a tendency — to ferment, and this is the great difficulty in extraction. In making olive oil with the Mission olives without drying, the result seems to be that the water of vegetation is in such large quantity that it holds the oil to itself and to the solid matter too long. * * *. The process of oil extraction from olives grown along the foothills proved much easier than from those at my place, and the quality of the oil much superior, so that it seems that we shall find perhaps in the hills the point at which the Mission olive may be as fine as any other. * * * I think that eventually we shall perhaps find the particular olive best adapted for each particular locality. Where the soil is over-rich the tendency is to produce too much solid matter. As in wine-making, there is always the difficulty of having so much solid matter that it cannot be removed before the wine has been affected."

*Edward E. Goodrich, Report of Third Olive-Growers' Convention (1893), p. 24.

OLIVE ORCHARD SCENE AT SANTA BARBARA,
AT THE BASE OF THE SIERRA MADRE RANGE; ALTITUDE, 400 FEET.

* "I have six olive orchards in different locations. The one on the lowest land is in what is known as black adobe. When it gets wet no animal can travel over it. It is probably sixty feet above the level of the sea. Another is in black adobe that is probably one hundred and sixty feet above the level of the sea; another is in sandy loam, composed of soil washed down from hills and mountains. I have another orchard that is in what we call red lands, something similar to the red lands about Redlands, four hundred feet above the level of the sea and on a side hill. I have also, alongside of it, at the same height, an orchard in solid black adobe, within a quarter of a mile of the same place. I have another about four hundred feet above the level of the sea, in sandy loam. Of course I make oil from these olives as they ripen. But I have the trees in a great many different locations under different circumstances, and thus I have ripe fruit in some orchards perhaps a month before it is ripe in others, so that I can begin early and continue the oil-making until late. The oil I made two years ago I had in seven different tanks or vessels. That made from one orchard, first; and from a different orchard, second; third, fourth, and so on, down to the end of March, when I finished. Excepting the first tank, I could see no difference in the oils. No man could detect a difference in taste, color, or weight. Regarding the fatty matter that Mr. Goodrich speaks about in the Mission olive, on some lands, there is so much fatty matter that the oil is too thick. As a matter of absolute knowledge as to the difficulty in extracting the oil from the different orchards, I have not been able to discover any; but my olives are always very perfectly dried. I have four or five different drying-houses. The olives are put in these drying-houses in very thin layers, and the heat is kept at about 120° F.; they are not taken out until they are thoroughly ready for the crushing, and that is a great factor in making oil. The probability is that one half of the weight passes off in the moisture, and after I get these olives in that condition they will be spongy and rather greasy; that is, if one puts his hand on them he can tell in the dark whether they are ready to crush or not, by simply feeling them. If they are allowed to go beyond this condition and

* Hon. Ellwood Cooper, Report of Third Olive-Growers' Convention (1893), p. 26.

become hard the oil cannot be extracted. When the olives are dried as I have described, I have not discovered any difficulty in separating the oil from the solid mass of pulp."

Time to Gather the Fruit for Oil Extraction.*—"I commence picking in December, or as soon as the olives turn a purple color—some of them probably only a reddish color, one side partially green, but ripe enough for making oil. They require more drying then than they do in the month of March or April, when the water will have evaporated mostly from the

Gathering olives, showing the use of the "Titus" extension ladder on wheels.

fruit while hanging from the limb. That, of course, has to be governed by the intelligence of the person managing the drying. It is supposed that the oil is of a lighter color made earlier than it is when made later in the season; but as we make it all in the same tank I do not apprehend there is very much difference as to the color of the oil or as to the quality. In Europe they dry the berries almost altogether in the sunlight. In the coast counties here that is impossible, because we may have a series of foggy days during the process of drying which would render the work impossible."

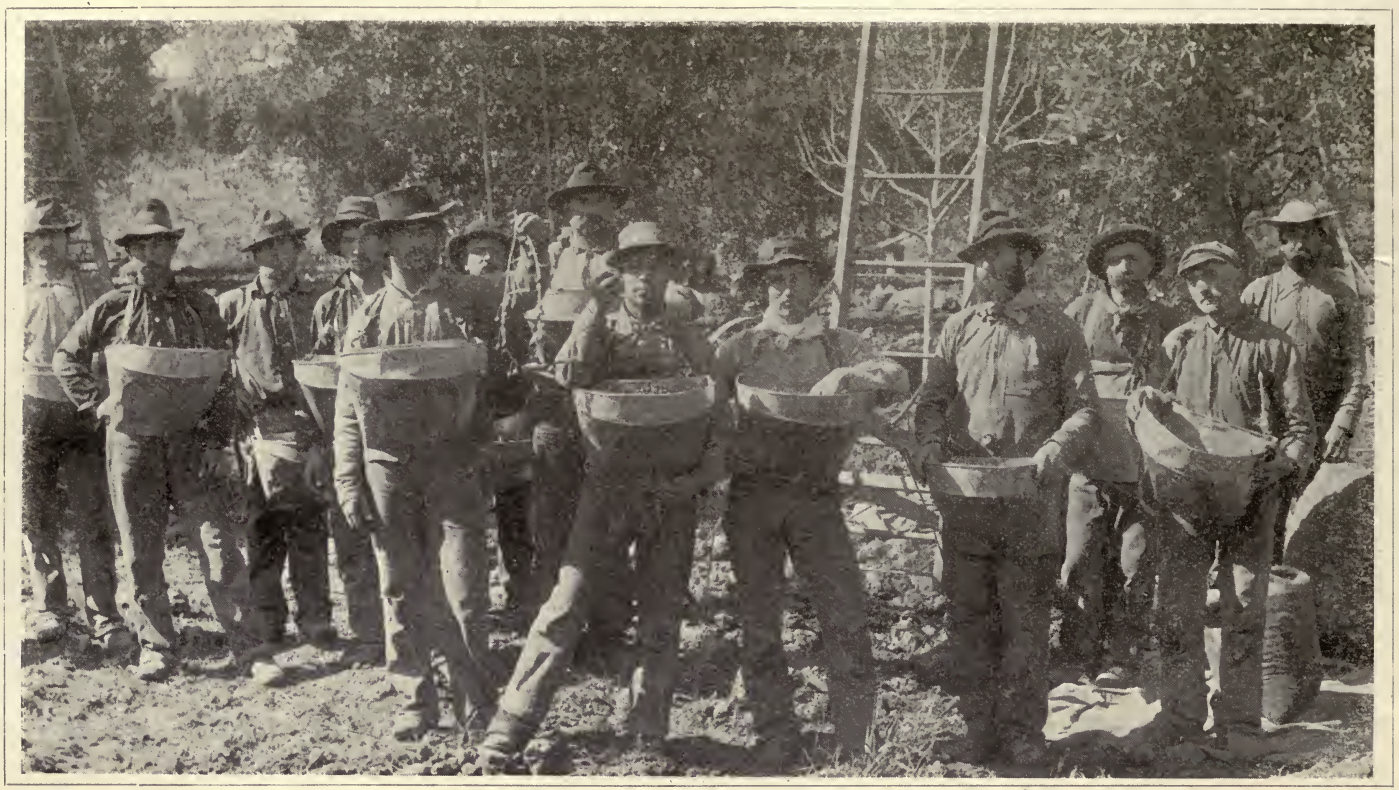
*Hon. Ellwood Cooper, of Santa Barbara.

PICKING APPARATUS.

The picking by hand of such small fruit as olives, from large trees, becomes a very important factor in the success of olive culture, and must be done expeditiously and as cheaply as possible. The fruit of young trees is picked by the use of ordinary stepladders, but to reach the fruit of large trees from twenty to forty feet high requires special contrivances, of

Gathering olives by the use of stepladders.

which there are many in use. The old method of knocking the berries off with a pole is not practiced in this State, as the injury to both the fruit and the tree is too great. In several orchards there is used a common ranch wagon with a platform, on which are fastened several ladders that lay up against the tree. The pickers gather the fruit by pulling it with both hands into an apparatus of canvas made in the form of a scoop. The berries are then passed through a powerful fanning mill, such as used for cleaning grain, which blows out all leaves, rubbish, and dirt. They are then ready for the drying-house. Mr. Cooper uses what is known as the "Titus" ladder, mounted and supported on wheels (see illustration on page 67). These ladders are very convenient, as they are wheeled about with ease, and do not injure the tree in any way.



GATHERING OLIVES.

SHOWING BUCKETS USED IN PICKING THE FRUIT AT HON. ELLWOOD COOPER'S ORCHARDS, AT ELWOOD, NEAR SANTA BARBARA.

OLIVE OIL FILTERING OR CLARIFYING.*

"This is a simple process. The most common method is to have a series of five or six boxes, one above the other, each with cotton batting in the bottom. The oil passing the sixth will be beautifully clear and ready for market. I use cylindrical tin vessels holding about three gallons each, one fitting in the other, in tiers of three, with fine wire sieves in the bottom of each. On these sieves I place two or three layers of cotton batting. The oil is passed from one tier to the other until clear. The clarifying can be done by sunlight; also, the oil can be bleached and made much lighter in color, but not without injuring it. When it is adulterated, artificial heat is necessary in the process. When once heated it loses a part of the nutty flavor, and is liable to become rancid when exposed to the air. It should be kept in an ordinarily cool place, not exposed to sunlight or heat; neither should it be handled any more than is absolutely necessary in the filtering and bottling, and should not be shaken after bottling. The mucilage contained in the oil will not separate for a long time after the oil is ready for use, and as it does not injure it, is not therefore objectionable. It will sometimes form in the bottles like globules of water, or in films, settling to the bottom as sediment, and when shaken will give the oil a muddy appearance, which, with the common prejudice against all table oils that are not perfectly clear, renders it unsalable, as consumers consult more the eye than the taste. The oil is better when new and fresh, and what is gained in appearance by its remaining a longer time in the tank is more than lost in its freshness and delicacy of flavor."

*Hon. Ellwood Cooper, of Santa Barbara.

PICKLING, PROCESSING, ETC.

Olives are pickled in four stages of ripeness: (*a*) Green—before ripe; (*b*) Reddish cast—when the olives have become a dark red color, before changing to black; (*c*) Ripe—when the olives have become black; (*d*) Dead ripe.

Green Olives.—The fruit is picked with care, into lined baskets, just as it has reached full size, and before indications of ripening begin, which is shown by tints of red forming on the fruit.

After years of experimenting in the production of pickled olives, I have obtained best results by pursuing the following course: The olives are placed in shallow vats, which have previously been half filled with water, to prevent any fruit from being damaged when being emptied into them. The vats are filled with fruit to about seventy-five per cent of their capacity. A lye solution is then made in another vat, either above the one containing the fruit or near it. *Fifteen* pounds of pure potash or Greenbank powdered caustic soda are dissolved in a wooden tub, containing from five to ten gallons of water. The potash or caustic soda is first placed in the tub and the water added. If the soda be used, the water must be cold; if the potash be used, the water must be hot. The soda generates great heat and readily dissolves in the course of a few minutes. In another tub is dissolved six pounds of lime, which is allowed to settle. The clear liquid is then drawn off and added to the lye. Water is then added to make in all one hundred gallons of solution. The plug in the vat containing the fruit is then drawn out and the water in which the olives have been is allowed to run out. The fruit is then covered with the lye solution. The room must be darkened and no current of air allowed to pass through it during the changing of the lye, for exposure to light and air will change the color of the fruit from green to a coffee brown. The fruit is kept in this condition until the bitter principle is neutralized by the lye, which varies, according to variety, from twelve to sixty hours. The lye is then allowed to run out, and immediately water is run in and the vat filled

to the top. The water is changed every day for four or six days, until every trace of lye is removed, which can be told by testing. The fruit is cut with a knife, and if there is no lye around the pit it is then time to add the brine. At first it is best to put a light brine—six ounces of salt to the gallon of water—on the fruit, because it prevents the fruit from discoloring and shriveling. After the fruit has been thoroughly pickled and the color firmly set, so that it will not discolor on being exposed, it is put into a stronger brine made of twelve or fourteen ounces of salt to the gallon of water, and in three to four weeks it is ready for market.

The success in pickling green olives so that they will retain that delicate green color, depends on the care and precision taken in running off the lye, the immediate covering of the fruit with water, the darkened room, the prevention of draughts passing through the operating-room while the water is being changed, the purity of the chemicals used, and the care in making the brine.

Reddish Cast.—Olives of a reddish cast, or before fully ripe, are selected and pickled separately. If cured by the lye process, they keep longer than fully ripe fruit pickled by the same process. If cured by the water process, they become greatly discolored, owing to uneven ripeness.

In pickling olives in this state of ripeness, it is best to add to the lye solution the clear liquid of at least ten pounds of lime, to set the color.

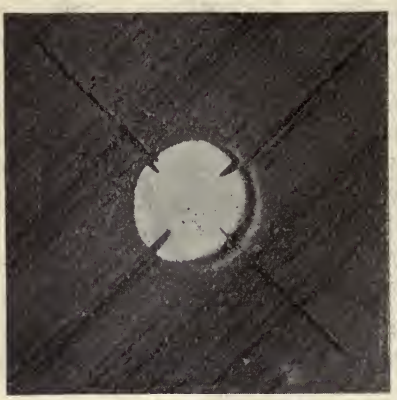
Ripe.—This state of ripeness is indicated by the jet-black color olives assume. The fruit must be perfectly sound. They must be picked from the tree by hand, and the trees gone over several times, unless they be of a variety of even ripening. After having been assorted, they are placed in vats half full of water, to prevent bruising, and when three-quarters full the water is run off and the fruit covered with the lye solution. They are kept in the lye until the bitter principle becomes neutralized, which varies, according to variety, locality, soil, and climatic influences, etc. During the operation the fruit should be tested from time to time by taking out a few, washing them in clear water, and then cutting the fruit with a knife. If the lye has only penetrated a short way they

should be left longer in the lye, or until all trace of bitterness is removed. The lye is then run off and water run in immediately, which is changed every day or so, until no trace of lye is found in the fruit. A light brine, made of six ounces of salt to the gallon of water, is then put over the fruit, in which the fruit is kept a week or more. This light brine is then run off, and a stronger brine, consisting of fourteen ounces of salt to the gallon of water, is put on the fruit. It is very essential that the first brine should be weak, as a stronger brine tends to shrivel the fruit, which destroys its commercial value. After the olives have been in the last brine two or three weeks, they are ready for market, and must be then put into a specially prepared brine. Olives grown in varied situations differ in bitterness, and it often happens that a second (or a third) application of lye becomes necessary to neutralize the bitter principle in the fruit.

Dead Ripe.—Many prefer pickles made from dead ripe fruit, *i. e.*, fruit that has shriveled on the tree. The processing of fruit on a large scale at this stage of ripeness necessitates extreme care. It will not withstand the lye treatment, and it it is only occasionally that any degree of success has been attained by the water process. Families, however, find no difficulty in processing olives in a small way at this stage of ripeness, and they are most palatable, owing to the abundance of oil in the fruit.

Water Process.—While this process is the oldest in use, it is one that requires patience and care. Well-cured olives by this process keep longer and possess more nutrition by way of percentage of oil than fruit which comes in contact with lye and which must naturally lose a certain per cent of oil while undergoing pickling. The olives are gathered when black or of a purple color, placed in wooden vats or barrels, and covered with fresh water, which is changed every day until the bitter principle is removed. Many growers change the water every other day, and claim that the bitterness is more quickly extracted. The extraction of the bitter principle requires from thirty to sixty days, according to conditions.

Slit Olives, Water Cured.—By no method is there a more appetizing olive pickle put up than by this process; while it is very simple, more care is required than in any other. The fruit must be choice, well selected, and of even ripeness. The olives are picked by hand into baskets or boxes lined with burlap or cloth and something placed in the bottom to keep them from being bruised. When they are brought in from the field they are at once turned into barrels of water. A lot of the berries are dumped upon a padded table, which rests upon a barrel filled with water. The help standing at these tables pick out the blackest ones and run the rest down into the water. These black ones are the ones cured. The help (women preferred) seated at tables with cutting knives prepare them for the treatment. The knife is a block of wood with a hole just large enough to allow a good sized olive to pass through. There are four little knives (although two are preferred by many) of very thin steel projecting into the hole. As the olive is pressed through it is given four straight, even cuts, and then falls below into a keg of water. The olives remain in these kegs (the water in which is changed every day or two) until the bitterness is removed, when the olives are put into brine and are ready for market. The fruit, being slit, requires less salt than when prepared without slitting. Too strong brine has a tendency to injure the flesh of the berry and soften the fruit. Brine made of ten ounces of salt to the gallon of water is best suited for slit olives. After the fruit has been put into kegs or barrels the brine is liable to become "strong," due to leakage, evaporation, or exposure to the air. It should be drawn off at intervals and replaced with newly made brine. Fruit should never be allowed to remain in brine that has become foul; but when the proper precautions have been taken, brine should keep in prime condition for a season or more.



Slitting board, or cutting device for slitting olives.

Lye Process.—I have heretofore recommended the use of potash instead of caustic soda, because potash has not the bleaching effect that caustic soda is known to possess. From the results of former experiments I also recommended the gradual neutralization of the bitter principle in the fruit, by a weak solution of potash, changing the same from two to four times until this was accomplished. In recent experiments I find that caustic soda can be successfully used, but with the addition of lime. The caustic soda used must be pure, the lime being added to prevent bleaching and to set the color. Caustic soda, or any other solution (even water), takes away the natural color of the fruit. Lime when added restores to the fruit the color removed by the caustic soda and renders the fruit of a uniformly dark color, which, while artificial, is not easily detected from the natural. Again, caustic soda is obtained in the market strictly pure, and in a powdered state, requiring no boiling to dissolve it, only the addition of water. The same applies to the lime, thereby doing away with the necessity of purchasing boilers and fuel, which are required when potash is used, these articles being expensive and cumbersome, especially when large quantities of fruit are to be processed. The strength of the lye I now use on both ripe and green fruit, although varying according to variety and state of ripeness of the fruit, is as follows:

Powdered caustic soda, pure	15 pounds.
Lime	6 pounds.
Water	100 gallons.

Place the caustic soda in a tub or bucket made of wood (oak preferred), add slowly five to ten gallons of cold water, and stir. In another vessel slack the lime in about the same amount of water. Allow the lime to settle; then pour the clear liquid into the caustic soda; add water to make in all one hundred gallons of solution, and apply to the fruit cold. The fruit is kept in this lye solution until the bitter principle has entirely disappeared. The lye is then drawn off and immediately fresh water run in, in fact it is best for the water to run in as the lye is running out. The water is changed every day until all trace of lye is removed, then brine is added.

Olives in Oil.—Olives in oil form a most appetizing dish, and are greatly relished. They do not need special prepara-

tion. Olives pickled by any process, although ripe, are taken from the brine and covered with *pure* olive oil. They may be eaten immediately, but improve in flavor if allowed to stand over night. For this purpose the slit olives are most preferred.

Other Recipes.—There are many other recipes in vogue for pickling olives. The following are used by some of the leading growers:

By Ellwood Cooper, of Santa Barbara.—For ripe olive pickles, gather the fruit when of purple color. They must be picked and handled with great care, being dropped into water to avoid bruising. In pickling, we handle the fruit in water, and aim when changing the water to get the olives which are at the bottom one day on top the next, changing the water every day. By this careful method none will turn out defective. After changing the water every day for thirty or forty days, according to ripeness, make a mild brine of best Liverpool salt, about half as strong as would bear an egg, and leave the fruit in the brine for two or three days. Remove from the brine and wash in cold water, taking care as before not to bruise the fruit. Then make a brine to bear an egg, boil it, and pour over the fruit when cold.

By Frank A. Kimball, of National City.—The olives are carefully picked and must be handled without bruising. A good stage of maturity is when the fruit is quite red and before it has turned purple. When picked the fruit must be immediately covered with a solution of concentrated lye, in the proportion of two ounces of lye to each gallon of olives, and every olive must be entirely covered by the lye solution. A portion of the solution should be frequently drawn off and poured on top to keep it of equal strength. After twelve hours examine and see how far the lye has penetrated. When it has nearly reached the pit (which is easily shown by breaking open some of the fruit) draw off the lye and replace with soft, clear water, which should be changed once or twice a day until no trace of lye is left in the fruit. This is best determined by testing with litmus paper. After this add salt to taste, provided the olives are to be used immediately; but if they are to be kept for future use the brine must be made of the same strength as for preserving meat, and when required for use may be

freshened to taste, using cold water for the purpose. Perfectly ripe olives prepared in the same way are far more delicious, but must be picked and handled with extreme care so that none shall be bruised; they will not keep so long as those pickled before having reached such maturity. During the process of pickling, the olives must not be exposed to light or air. It is important that only one size of olives should be processed at the same time, else the smaller ones will be spoiled before the larger ones are "done," and it is absolutely essential that everything used in processing olives should be perfectly "sweet," as any offensive odor will be absorbed and the fruit rendered worthless.

By A. D. Thacker, of Pomona.—On receiving the fruit from the orchard, I sort it into three sizes by means of a grader made especially for olives; then each size is separated by hand according to color. This is essential, in order that the work of neutralizing the bitter principle may be uniform in all respects, for too much care cannot be given to the removing of the lye as soon as it has reached the pit of the fruit, and in extracting the lye from the fruit, for if left in the lye solution or water too long, a soft or mushy olive will surely be the result. When so graded and separated the olives are placed in cement vats, and covered with concentrated lye made to the consistency of one can to five gallons of water, a cover being put over them to keep them under the lye. I lift the cover and carefully stir them as often as once in six hours, and continue to do so until all the bitter principle is neutralized. The lye is then drawn off and water turned in; in fact, the water is turned in as soon as the lye begins to flow out, in order to continually keep the olives under cover, thereby not exposing them to the air. As soon as the lye is all out I wash the smut* from the fruit (which now readily leaves the olive), keeping the outlet in the vat open so that all smut or dirt may readily pass out. When the olives are clean and bright I then close the outlet, letting the olives remain under cover away from air and light. I change the water every six hours until all the lye is extracted from the fruit, using pure artesian water. The length of time required to neutralize the bitter principle in the fruit depends largely upon the variety of olives and the condition of the weather just

*Refers to black smut which exists in the bay and coast counties or wherever the black scale abounds.

before picking the fruit from the trees; never less than twenty-four hours, and many times from two to eight days, changing the lye once or twice, depending upon the length of time required to neutralize the bitterness. The time required to extract the lye from the fruit also varies, depending upon the variety of the fruit and other conditions. When all the lye is extracted from the olives I remove the fruit from the vats (using wire shovels) and put it in barrels containing brine made of Liverpool salt and artesian water, using fourteen ounces of salt to each gallon of water. The barrels, after being headed up, are put aside for ten days, at the end of which time, if the olives are to go to market, the barrels are rolled out, the brine drawn off, and the barrels refilled with brine that has been boiled, skimmed, and cooled; if the olives are not to go to market the brine is drawn off and the barrels refilled with unboiled brine and again set aside until ordered to market, at which time the brine is again drawn off and the barrels refilled with boiled brine as above.

GRADING.

The grading of olives for pickling is very important. Large berries require a much longer time for the lye to penetrate to the pit in neutralizing the bitter principle than do smaller or medium-sized ones; therefore, if berries of all sizes were placed together in the lye solution, the medium-sized and small ones would have to remain therein until the larger ones became processed, and thus would be greatly damaged by remaining in the lye a greater length of time than was necessary. After trying all the graders recommended—some of which have done excellent work in grading other fruits, such as prunes, etc., but which were either too slow or unfit for grading olives—I perfected a grader which, for rapid work, accuracy in grading, etc., is not excelled. This grader consists of three trays, made of one-quarter inch material, twenty by forty-six inches, fitting one into another, with slats of three-quarter inch half-round molding extending the length of the tray. The slats are lined with cloth, which is wrapped around the slat before it is nailed down, to prevent bruising the fruit. The

olives are dumped into the upper tray, and by a gentle lift of one end the olives roll toward the other end. The small ones pass through the apertures and are held by the lowest tray, it having a bottom. The first size is held by the upper tray and the next by the one in the middle. These two sizes are the ones to be pickled. If other sizes are wanted, other trays with apertures of different sizes are added. The trays containing the different grades of fruit are separated and the fruit put into different vats. The fruit of the lower tray, being too small for pickling, is separated from leaves and rubbish, by passing it through a bean or raisin blower, and converted into oil.

PESTS AFFECTING THE OLIVE.

The olive has so far enjoyed freedom from the insect pests existing in European olive belts, which are yet unknown in this State. The following are the most formidable pests that the growers have to contend with:

Black Scale (*Lecanium olea*, Bernard).—This scale is widely distributed over the State, particularly in the coast and bay counties. It does not seem to thrive in the interior counties, as the intense heat of summer destroys the young during breeding time. The excrement from this scale, being deposited on the leaves and fruit, forms a smut, which is very detrimental to the growth and fruitage of the tree and also detracts from the real value of the fruit either for pickles or for oil.

The most approved *remedies* employed for the destruction of this scale on the olive are the following:

Kerosene Emulsion—Cooper's Formula.

Kerosene, 150° test	5 gallons.
Common soap (laundry)	1½ pounds.
Water	2½ gallons.

Boil the soap and water until the soap is thoroughly dissolved; place in a tub or barrel, add the kerosene, and churn with a dasher or pump through a nozzle until emulsified; then

use, first diluting one gallon with six and a half gallons of water, and to this mixture add two and a half pounds of good home-made soap dissolved in hot water. All the mixing should be done with *hot* water, and the emulsion should be applied at a temperature of 140° F. During spraying great care must be taken not to allow the kerosene to rise to the surface of the water. The best way to prevent this is by one man doing the stirring while the other men do the pumping and spraying.

Kahles' * Distillate Solution.

Distillate 28° (untreated)	5 gallons.
Hot water	5 gallons.
Whale-oil soap	1½ pounds.

The whale-oil soap must first be dissolved in the water; then add the dissolved soap to the distillate. It is important that the distillate be placed in the mixing vessel first, then place the dissolved soap on top. Then attach your spraying pump to the bottom of the vessel in which you are mixing the compound, and keep pumping it out of the vessel through the spraying pump back into the vessel, until the whole becomes of a rich creamy substance. Keep pumping or churning it through the pump until it becomes a complete emulsion, without a speck of free oil in sight, which will take from ten to fifteen minutes. When properly emulsified, it should increase in volume about one third, because it becomes aërified.

If the ground is in good condition, containing proper moisture, and the trees are healthy and growing, you can apply the spray in the proportion of eleven parts of water to one of the emulsion. Always put your emulsion in the apparatus first, then add the water. The stock compound and the cold water will mix as readily as milk and water, and when finished should resemble milk in all appearances. If the trees are dormant, do not use it so strong; say, about twelve or fourteen gallons of water to one gallon of the stock compound. When spraying be careful to observe any particles of oil which may not have been thoroughly emulsified, and which rise to the surface. In this event, do not pump it all out, but only that which is the correct emulsion, and when near the bottom empty the oil off.

* F. Kahles, Superintendent of Crocker-Sperry Lemon Grove, Montecito.

About two hundred gallons of the stock mixture can be made for $6.25. The distillate costs 5 cents a gallon, and the soap about 5 cents a pound. Two hundred gallons of stock mixture, at 11 to 1, give 2,200 gallons of spraying solution.

This solution is made the same as the kerosene emulsion, only this distillate contains all the natural oils and strength of the crude oil, nothing being taken therefrom except the asphaltum. Therefore, it is a great deal stronger, and stays longer on the trees without evaporating. Orchardists should use extreme care in the preparation of this solution and apply it on the trees at the proper time and under competent supervision.

Rosin Wash for Newly Hatched Black Scale.

Rosin	18 pounds.
Caustic soda (78%)	5 pounds.
Fish oil	2½ pints.
Water, to make	100 gallons.

Place the rosin, caustic soda, and fish oil in a boiler, pour over them about twenty gallons of water, and cook thoroughly over a brisk fire for at least three hours; then add *hot* water, a little occasionally, and stir well, until you have not less than fifty gallons of hot solution. Place this in the spray tank and add cold water to make the necessary amount. The great secret in the successful preparation of this wash is never to add *cold* water when cooking, otherwise the rosin will be precipitated. It is difficult to again get it in solution. After the materials are thoroughly cooked and diluted with the proper amount of hot water, the solution should be poured into the tank through a very fine brass wire sieve or piece of thin open cloth. This will remove any debris that would become lodged in the nozzle, causing annoyance and delay when spraying. This solution will be found very effective, if applied in September or not later than the end of October. It is one of the cheapest and most effective washes, costing less than one cent per gallon.

Twig Borer (*Polycaon confertus*, Le Conte).—This borer at times does great injury to olive trees, especially to those of recent planting. It bores into the stem, above a twig, downward, and deep into the pith, also gnawing considerable of the wood. The branches generally break of their own weight, de-

stroying the symmetry of the tree. It is well to look the trees over, especially if newly set out; whenever one is found having a hole emitting sawdust, poke a sharp wire into the hole and give it several turns, thereby destroying the borer, which is invariably inside. If the limb has broken or cracked from the effects of the borer, it is best to cut it off. As the trees grow older they somewhat resist the ravages of the borers, which seldom attack large limbs. The beetle is about half an inch in length, of a dark pitch color, having on its wing-covers small or very minute hairs, and is generally covered with a yellowish powder.

Mature insect, enlarged.

Branch of olive tree infested with black scale (*Lecanium olea*), showing larvæ of *Rhizobius ventralis* feeding on same.

Natural Enemies of the Black Scale.—The black scale has numerous natural enemies, among which is the twice-stabbed ladybird (*Chilocorus bivulnerus*), which aids in lessening their number to a considerable extent annually; also, many other

of our native insects, like the lace-wing fly (*Chrysopa californica*), syrphus fly (*Catabomba pyrastri*), and a minute internal parasite (*Dilophogaster californica*).

Male, enlarged. Larva, enlarged. Female, enlarged.

BLACK LADYBIRD (*Rhizobius ventralis*).

The combined efforts of all of these friendly insects did not materially decrease the scale until a black ladybird (*Rhizobius ventralis*) was introduced by the State Board of Horticulture from Australia. Singularly, though this ladybird has increased enormously wherever it finds humid atmospheric conditions, in interior localities, where the atmosphere is dry, it has not developed with such rapidity.

Collecting Rhizobius beetles for distribution among orchards infested with black scale.

The ladybirds are collected and placed on the trees just before sunset. The beetles fly from tree to tree, and in this way scatter throughout an orchard. Many thoughtful growers aid the ladybird in colonizing by carefully collecting the beetles from certain trees and liberating them on other portions of the orchard. Before winter sets in inverted corn husks are tied among the branches of the trees for the purpose of giving shelter to the ladybirds, so that they may not perish during the cold winter months.